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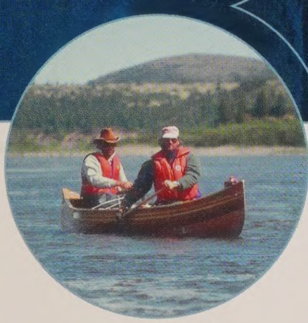
Environmental Signals



Canada's National Environmental Indicator Series 2003

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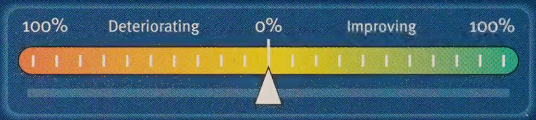

Meter Description

A meter is included for each environmental issue, as illustrated above. Each meter reflects a trend over time for the indicator that best summarizes the environmental issue. It shows whether the indicator is deteriorating, remaining stable, or improving, and to what degree. Each graph depicting the data on which the meter is based appears first in its section and is accompanied by an explanation of how the trend was measured. In most cases, the meter calculations are based on a change over the past decade.

The meters cannot be compared to each other. Each meter value should be seen only as a highlight of the rate of progress that is occurring in the issue. They do not allow comparisons of the relative importance of issues, and they do not show change with respect to specific science-based thresholds. Furthermore, the meters provide a national roll-up and therefore do not represent regional variation.

Please see http://www.ec.gc.ca/soer-ree for the online version of this report as well as up-to-date information and technical backgrounders on the indicators in this report.

Environmental Signals

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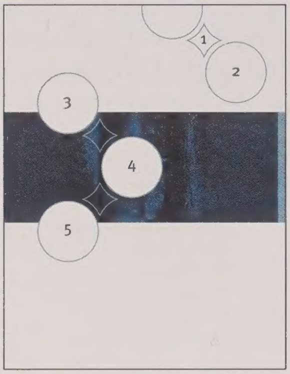

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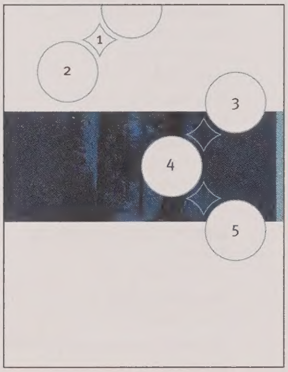

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Introduction

For many years, Canadians have been clearly concerned about the environmental issues that affect their health and the health of ecosystems. They are increasingly seeking information on progress made towards managing issues such as air and water pollution, endangered species, the release of toxic substances, and the use of Canada's natural resources. The Government of Canada is strongly committed to working towards environmentally responsible decision-making at all levels of society and to making reliable environmental information available on which to base these decisions.

Environmental indicators provide an effective means by which complex environmental data can be transformed into easy-to-use communication and decision-making tools – tools that can help us keep track of the state of the environment and measure progress towards sustainable development. Ideally, environmental indicators can be used in much the same way that economic indicators have been for many years.

Canada began developing a national set of environmental indicators over 10 years ago. At the time, the notion of sustainable development, effectively put forth by the World Commission on Environment and Development in its 1987 report, "Our Common Future," brought with it an imperative for more and better environmental information. Subsequently, the 1989 G7 Economic Summit in Paris called for the development of environmental indicators to measure the state of the environment and the relationship between the environment and economic development.

To achieve this goal in Canada, an Indicators Task Force led by Environment Canada was created to establish a framework for developing indicators, conduct a broad survey of key opinion leaders and potential users, and define criteria by which indicators would be selected. The interviewees surveyed stated that these indicators would be useful for day-to-day decision-making if they were perceived as catalysts that could "spark behavioural and ethical changes" among Canadians and answer to "intelligent public concern" for the environment. They also commented that indicators buried in government reports are of little use to the public and that results must be communicated clearly and understandably to the users. The indicators needed to relate to things that people value or identify with, be directed to something requiring attention or action, illustrate changes in a reasonable time frame, and be flexible enough to respond to changing scientific data and public opinion.

Subsequently, a preliminary set of environmental indicators, based on existing information and monitoring, was identified. Initially, this set contained 43 indicators in 18 issue areas. In the 10 years that followed, the indicators were further developed, updated, and published regularly as concise, easy-to-read bulletins, each representing a separate issue area. It is clear that this set does not yet present indicators on all environmental issues of importance to Canadians and for all regions of Canada. Indicator gaps are also apparent in many existing issue areas, particularly in relation to human health and ecological effects, where the monitoring and data collecting have historically been limited.

Environmental indicator programs are now in place throughout Canada and internationally. These programs have grown in response to the needs of decision-makers at many levels, from the local, regional, and national to the international, as well as the needs of scientists to communicate their findings more effectively. Regional offices of Environment Canada have developed ongoing and growing indicator programs to report on regional ecosystem issues. Other levels of government (municipal, provincial, territorial) and other government departments and organizations have developed environmental indicators related to their mandates (e.g., Agriculture and Agri-Food Canada's Agri-Environmental Indicators; Canadian Council of Forest Ministers Criteria and Indicators of Sustainable Forest Management in Canada). The challenge is to bring together many of these indicator initiatives to contribute to a national picture of the state of sustainability.

To achieve this next step in the evolution of environmental indicators for Canada, we propose the development of a "core set" of indicators – a single, recognizable set using the soundest approaches from all jurisdictions. Through renewed attention to integrating and organizing environmental knowledge, some gaps will be filled, and better ways of communicating information on the state of the environment to Canadians will emerge. It is hoped that the discussions contained in this document will serve as a starting point for the development of this "core set" of indicators.

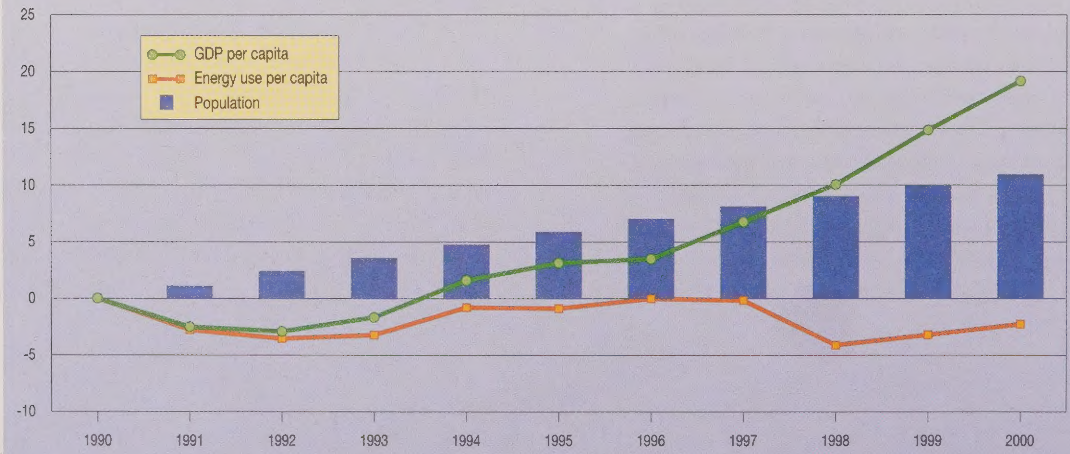
In this report, we present the entire National Environmental Indicator Series, providing a broad picture of the current state of Canada's environment, as well as the linkages between issue areas. Each issue area is structured in terms of the human activities that act as pressures on the environment, the condition of the environment, and societal responses to address the issue. Due to space limitations, only a brief selection of national and international actions that deal with each environmental issue can be provided. The report concludes with a look at what decisions individual Canadians can make to live more sustainably and the challenges and opportunities related to continuing indicator development in Canada.

Drivers of environmental stress

The impact of humans on the environment is a function of total population, per capita consumption and waste generation, and the type of technologies used. Globally, growth in human populations is seen as a major driver of environmental deterioration. With the present rate of world population growth, we are adding one billion people every 14 years, and each of these additional persons places demands on natural ecosystems. Compared with many countries, Canada has a small population relative to its large landmass and rich supply of natural resources. Even so, growing population numbers are having significant effects around some urban areas. Urban sprawl, particularly in southern Ontario and Quebec and the Fraser Valley and southern interior of British Columbia, is affecting sensitive ecosystems (e.g. wetlands, grasslands, freshwater bodies), placing stress on water and transportation infrastructures, and encroaching on some of the highest quality agricultural soils.

In Canada, individual lifestyles and the degree to which more environmentally benign technologies are embraced are as important indicators of environmental stress as is total population. The slight decline in per capita energy use since 1990, coupled with a significant increase in per capita economic growth, indicates that the Canadian economy is becoming more energy efficient. However, we do not yet have a powerful suite of measures that show the extent to which economic activity is impacting the environment. Over the coming years, as better indicators of the relationship between the economy and the environment are developed, we will be able to track how rapidly our economy is embracing environmental values and whether or not economic growth is depleting our natural capital.

Change in population, GDP per capita and energy use per capita (percent change since 1990)



Data source: Statistics Canada.

Adapted by: National Indicators and Reporting Office, Environment Canada.

Notes

Highlights

Over the past 10 years, significant improvements have been observed in the state of Canada's environment: concentrations of toxic compounds in some wildlife species have decreased; the acidification of many lakes has been reversed; air quality, while still a concern, has improved in some urban areas; and agricultural soils are now better protected from erosion.

Both individual Canadians and Canadian industries have begun to use some resources more conservatively and to tread more lightly on the environment. Significant decreases have been observed in some toxic emissions, acid-rain-causing sulphur dioxide emissions, the use of ozone-depleting substances, and per capita energy consumption. Per capita water use has declined slightly, and waste recycling has remained constant since 1998.

Governments throughout Canada have made important gains in environmental protection. For example, the amount of land strictly protected in Canada has increased from under 4% to over 6% during the past 10 years. Over the past 20 years, investments have been made in municipal wastewater treatment, resulting in a 20% increase between 1991 and 1999 in the percentage of the population served by more advanced treatment technologies.

However, significant challenges remain. Although improvements in acidification have been observed in many lakes, a significant number of lakes have shown no improvement, and some have become worse; the dramatic gains made in the 1980s in toxins in wildlife have levelled off and in some cases begun to rise again in the 1990s; air quality in some urban areas has deteriorated, and public health is still being compromised by poor air quality events; the stratospheric ozone layer over Canada still remains below pre-1980 levels; and most species designated as "at risk" by the Committee on the Status of Endangered Wildlife in Canada have shown either no improvement or a deterioration in their status since first being listed.

Canadians continue to exert significant and increasing pressure on some areas of the environment. Total energy consumption is growing, despite improvements in energy efficiency; gains made in automobile emissions and public transit use have been largely offset by increases in automobile travel and the use of larger vehicles; greenhouse gas emissions have increased by 20% since 1990, the base year for the Kyoto Protocol; and total municipal water use is on the rise, as is total waste disposal.

Canadians should take credit for the gains made in environmental quality since the 1970s. But there is still work to be done. For example, although Canada has nearly doubled the area protected since 1992, it is still far short of the United Nations suggested target of 12% protected. As well, although many Canadian ecosystems are well protected, other ecosystems have little or no protection.

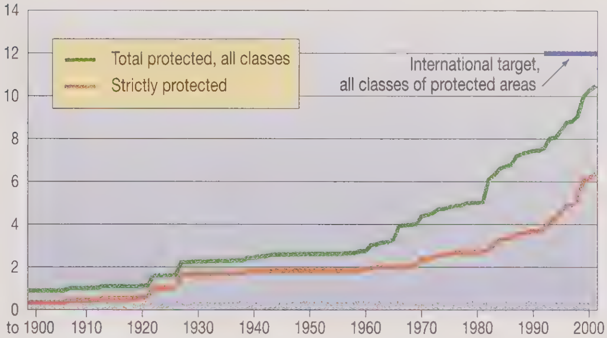
The brief summaries that follow present one key indicator for each issue area. The focus is generally on "state" indicators that depict the condition of the environment and "pressure" indicators that depict human activities that affect the environment. The indicators presented in this summary include those that are metered.

Biodiversity and protected areas

Percentage of strictly protected area in Canada has increased: up 70% since 1992

Canada is home to about 71 500 known species of wild animals, plants, and other organisms, as well as steward of a large proportion of notable ecosystem types, such as boreal forests and wetlands. The creation of protected areas is a key component of Canada's strategy to protect biodiversity. Since 1992, governments in Canada have doubled, to 6%, the land area designated as strictly protected. Over 10% has some level of protection. Although some large protected areas, greater than 10 000 square kilometres, have been created in recent years, most of Canada's protected areas are smaller than 10 square kilometres. Of the 194 terrestrial ecoregions in Canada, over 40% are without any strict protection. (See page 2)

Total and strictly protected land in Canada (percent)



Data source: Canadian Council on Ecological Areas Database; Canadian Wildlife Service, Environment Canada.

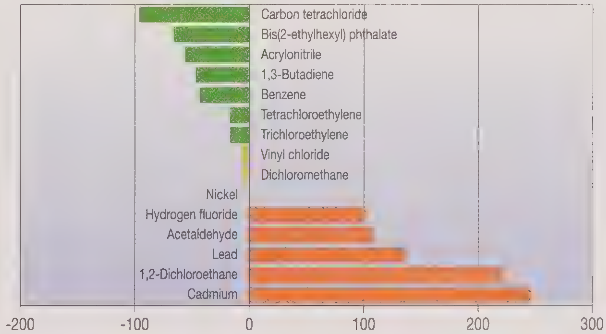
Adapted by: National Indicators and Reporting Office, Environment Canada.

Toxic substances

Some emissions increase, while others decrease

Reliable trend data are available in the National Pollutant Release Inventory for emissions of 15 toxic substances. Since 1995, on-site releases have decreased for 7 of these substances, changed little for 3, and increased for 5. In recent years, there has been important progress made in the management of toxic substances in Canada. The first step in managing a substance is listing it under the Canadian Environmental Protection Act, 1999 and there are now 52 substances listed. Some toxic emissions have declined significantly. For example, mercury emissions to air have declined by 77% since 1990. (see page 8)

Percent change in emissions of 15 CEPA toxic substances with matched data from 1995 to 2000



Data source: National Pollutant Release Inventory, Environment Canada.

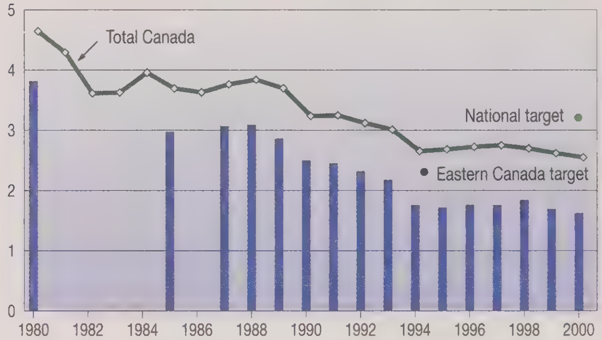
Adapted by: National Indicators and Reporting Office, Environment Canada.

Acid rain

Total sulphur dioxide emissions improved: down 19% since 1991

Acid rain is caused by emissions of sulphur dioxide and nitrogen oxides, which are converted to sulphuric and nitric acids in the atmosphere. Dilute forms of these acids fall to the Earth as precipitation or are deposited as acid gas or particles. In 2000; eastern Canada's share of emissions was approximately 1.6 million tonnes and under the regional cap. The area in eastern Canada affected by significant wet sulphate deposition shrank considerably between 1980–1983 and 1996–2000. Meanwhile, there has been little change in nitrogen oxide emissions and deposition. (See page 14)

Sulphur dioxide emissions for eastern Canada (million tonnes)



Data source: Criteria Air Contaminants Division, Environment Canada.

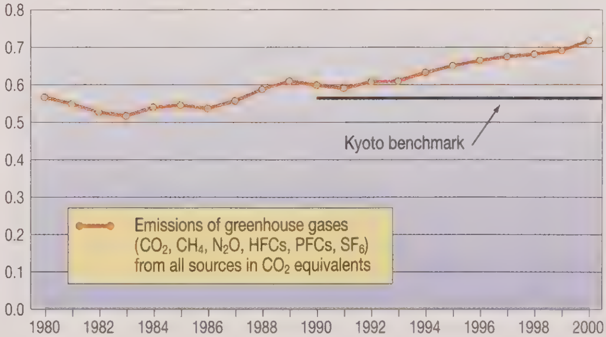
Adapted by: National Indicators and Reporting Office, Environment Canada.

Climate change

Canadian Greenhouse gas emissions up 20% since 1990

Greenhouse gases in the atmosphere trap solar energy that reradiates from the Earth's surface as heat. Gases emitted through human activities enhance this natural process. Canadian emissions of greenhouse gases have increased 20% since 1990, while average yearly Canadian temperatures have shown a warming trend, up approximately 1°C since 1950. Canada's Kyoto target is to decrease emissions by 6% below 1990 levels between 2008 and 2012. (See page 20)

Canadian greenhouse gas emissions (gigatonnes)



Data source: Greenhouse Gas Division, Environment Canada.

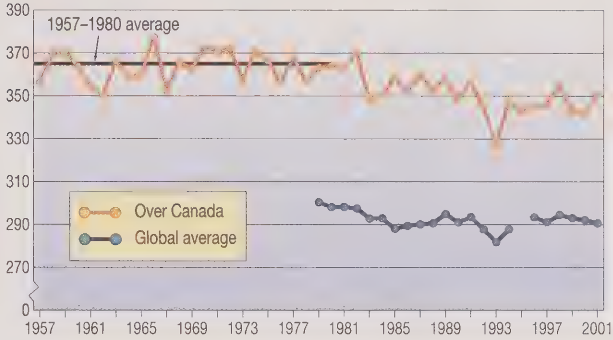
Adapted by: National Indicators and Reporting Office, Environment Canada.

Stratospheric ozone

Stratospheric ozone levels not yet recovering

Stratospheric ozone protects life on Earth by filtering out harmful wavelengths of ultraviolet radiation emanating from the sun. Emissions of ozone-depleting substances have reduced the concentration of ozone in the stratosphere, particularly around the poles. New supplies of ozone-depleting substances in Canada have fallen 96% since their peak in 1987. However, stratospheric ozone levels over Canada declined 1% since 1990 and 2–6% compared with pre-1980 levels and are not expected to begin to show improvement for at least 30 years. (See page 24)

Average annual ozone levels (Dobson units)



Data sources: Meteorological Service of Canada, Environment Canada; National Aeronautics and Space Administration, USA.

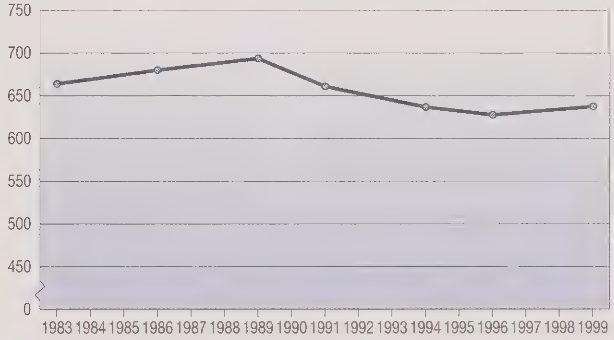
Adapted by: National Indicators and Reporting Office, Environment Canada.

Municipal water use

Per capita water use has changed little: down 4% since 1991

Canadians are among the highest water users in the world, using roughly twice as much per capita as in most other industrialized countries. The water available to most Canadians is under intense competition for municipal use, agriculture, thermal power generation, manufacturing, and mining. Municipalities use 11% of all surface water and groundwater withdrawn in Canada, more than half of which is for daily residential use. From 1991 to 1999, daily per capita municipal water use decreased slightly (4%), while total daily municipal water use increased by 5%. (See page 30)

Daily per capita municipal water use (litres per person)



Data source: Municipal Water Use Database, Environment Canada.

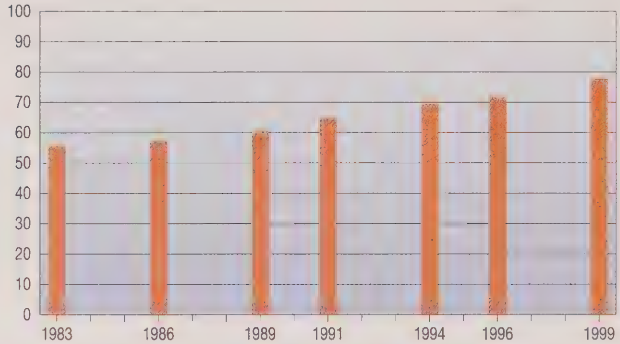
Adapted by: National Indicators and Reporting Office, Environment Canada.

Municipal wastewater treatment

Municipal wastewater treatment improving in Canada: up 20% since 1991

Municipal wastewater effluents represent one of the largest threats to the quality of Canadian waters. The release of untreated or poorly treated municipal wastewater effluents affects aquatic life and may put Canadians at risk from drinking contaminated water, consuming contaminated fish and shellfish, and engaging in recreational activities in contaminated waters. Although treatment levels vary from region to region, overall in 1999, 78% of the municipal population on sewers received secondary and/or tertiary wastewater treatment, up from 56% in 1983. As a result, estimated phosphorus loadings to aquatic ecosystems decreased by 44%, despite a 24% increase in the urban population. (See page 34)

Municipal population on sewers with secondary and/or tertiary treatment (percent)



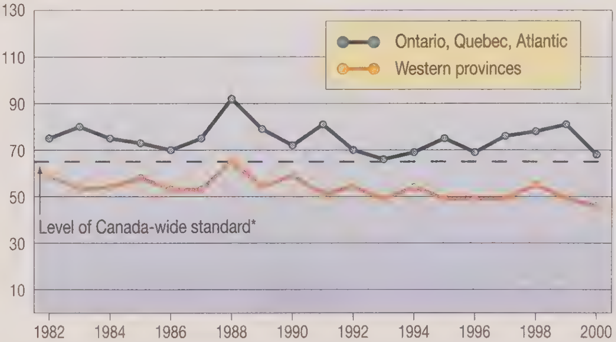
Data source: Municipal Water Use Database, Environment Canada.
Adapted by: National Indicators and Reporting Office, Environment Canada.

Urban air quality

Levels of ground-level ozone improving in some regions and deteriorating in others

Air pollutants emitted by the combustion of fossil fuels in motor vehicles, furnaces, factories, and industrial or thermal power plants adversely affect air quality. Direct emissions of air pollutants and emissions of precursor gases contribute to the formation of ground-level ozone and airborne particles, which are two of the key components of smog. Ambient concentrations of these pollutants have dropped in some urban areas, but there is still cause for concern. Ground-level ozone levels have not changed significantly across the country, with higher levels seen east of the Manitoba/Ontario border. (See page 38)

Average concentrations of ground-level ozone in Canada (parts per billion)



Data source: National Air Pollution Surveillance Network.
Adapted by: National Indicators and Reporting Office, Environment Canada.

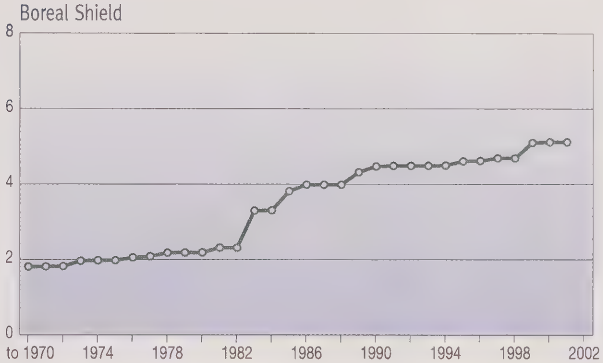
* The *numerical* level of the ozone Canada-wide standard (CWS) is included for qualitative purposes only. Achievement of the CWS numerical value is not required until 2010, and it can be assessed only if the conditions specified in the *Guidance Document on Achievement Determination* have been satisfied, which is strictly not the case for the data in the above chart.

Forestry

Percentage of ecozone with strictly protected forest area has increased: up 32% since 1992

Canada is home to 10% of the world's forests, including one-quarter of the Earth's boreal forests. Forests moderate climate, remove carbon dioxide, and are vital to the economy, through the production of wood and wood products. In response to increasing pressures on forested ecosystems, one of which is illustrated in the adjacent figure, the strictly protected area in the four most forested ecozones has been increased by 32% over the last 10 years. In these four ecozones, most populations of forest bird species have shown little change. (See page 44)

Percent of ecozone with strictly protected forest area in a selected forested ecozone



Data source: Canadian Council on Ecological Areas Database; Canadian Wildlife Service, Environment Canada.

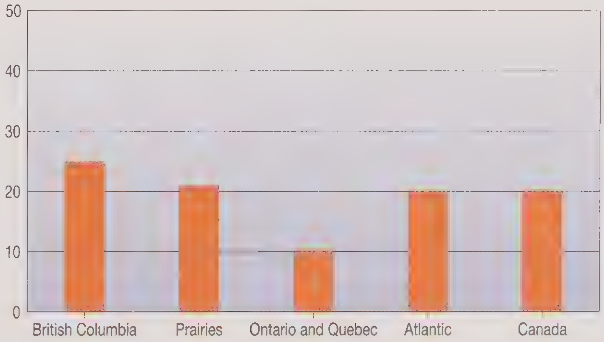
Adapted by: National Indicators and Reporting Office, Environment Canada.

Agricultural soils

Canadian agricultural soils are better protected: the number of days soil left uncovered by vegetation decreased 20%

Healthy soils are the foundation of sustainable agriculture. Erosion of agricultural land compromises the productivity and health of the soil, while excessive nitrogen pollutes groundwater and is emitted as a greenhouse gas. Between 1981 and 1996, the average number of bare-soil days in Canada's agricultural regions dropped by almost 20%. As a result, significant decreases have occurred in the percentage of Prairie agricultural land experiencing unsustainable wind and water erosion. However, residual nitrogen levels in agricultural soils increased markedly between 1981 and 1996 in all provinces except British Columbia. (See page 50)

Reduction in number of bare-soil days on agricultural land between 1981 and 1996 (percent change)



Data source: Environmental Sustainability of Canadian Agriculture: Report of the Agri-Environmental Indicator Project, Agriculture and Agri-Food Canada.

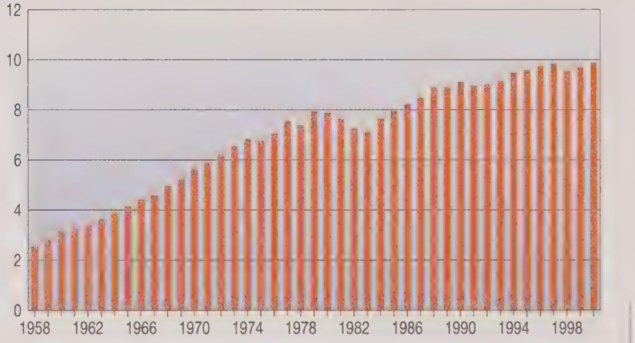
Adapted by: National Indicators and Reporting Office, Environment Canada.

Energy consumption

Total energy consumption has increased: up 10% since 1990

Canada ranks as the world's sixth largest user of primary energy, accounting for 2.5% of global consumption of energy and fossil fuel use in 1999. This high level of use can be attributed to vast travel distances, a cold climate, an energy-intensive industrial base, relatively low energy prices, and a high standard of living. Canada's energy consumption in 2000 was up 10% from 1990. However, Canada's per capita energy consumption decreased over the same period, indicating that efforts to reduce energy use and increase efficiency have worked to some degree. (See page 56)

Canadian energy consumption (exajoules)



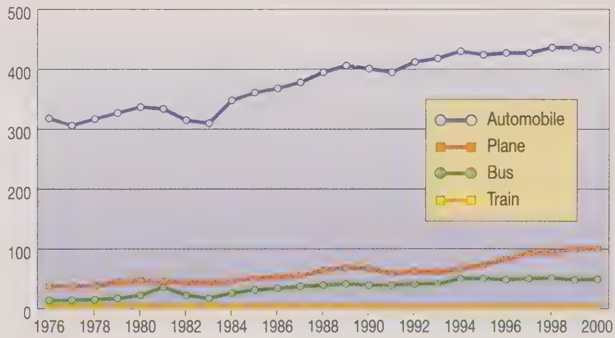
Data sources: Energy Division, Statistics Canada; Natural Resources Canada.
Adapted by: National Indicators and Reporting Office, Environment Canada.

Passenger transportation

Automobile use has increased: up 9% since 1990

Motorized transportation can stress the environment in a variety of ways: exhaust emissions contribute to urban air pollution, climate change, and acid rain; spills and leaks of fuel and other materials contaminate soil and water; demands for fuel deplete fossil fuel resources and road networks fragment wildlife habitat. Automobile travel, a significant subset of transportation, grew by 9% between 1990 and 2000. Urban transit's percentage of urban passenger travel has remained stable. Fuel efficiency rose dramatically between 1973 and 1982 and has been stable since; however, there has been an increased use of larger, less efficient vehicles. (See page 60)

Passenger travel, by mode (billions of passenger–kilometres)



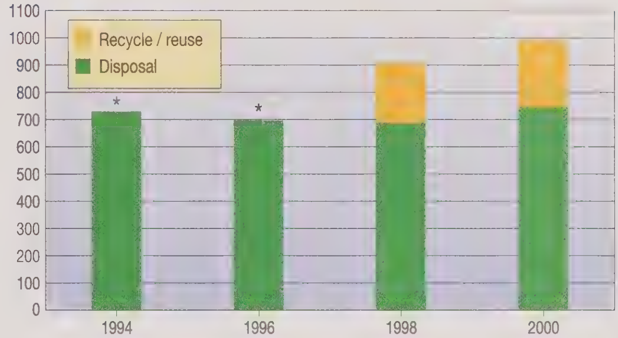
Data sources: Royal Commission on National Passenger Transportation, Canadian Urban Transit Association; Statistics Canada; Natural Resources Canada.
Adapted by: National Indicators and Reporting Office, Environment Canada.

Municipal solid waste

Per capita non-hazardous solid waste generation has increased: up 10% since 1998

Canadians are often cited as being among the leading per capita producers of municipal solid waste in the world. Inefficient production processes, low durability of goods, and unsustainable consumption patterns lead to excessive waste generation. Despite achievements in reuse, recycling, and recovery over the last decade, the amount of municipal solid waste generated per capita remains high and increased by 10% between 1998 and 2000. Industry and institutions generate 40% of this solid waste, while a third is generated by the residential sector. (See page 64)

Per capita non-hazardous solid waste disposal and recycling/reuse (kilograms per person)

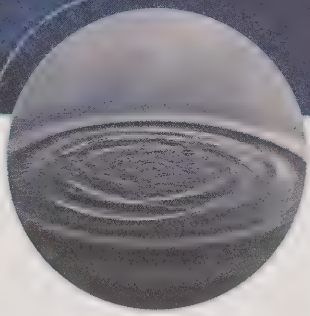


Data source: Waste Management Industry Survey: Business and Government Sectors 1994, 1996, 1998, 2000, Statistics Canada.

Adapted by: National Indicators and Reporting Office, Environment Canada.

* Recycling data not available for 1994 and 1996.

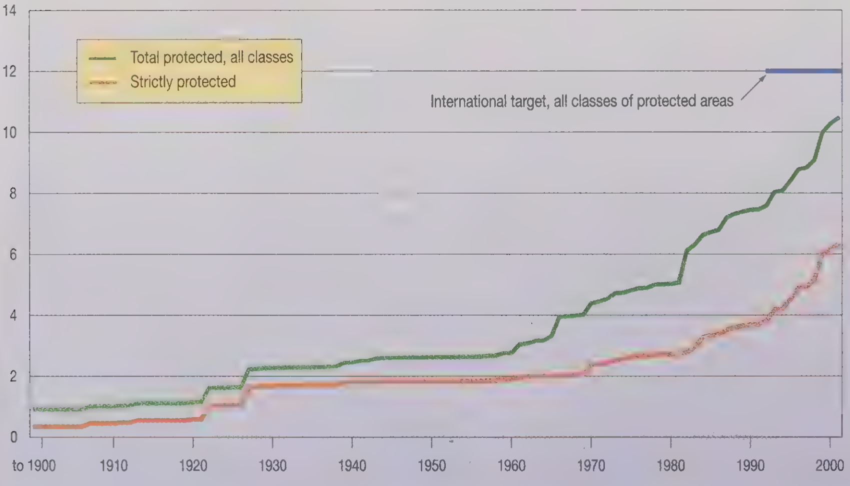
Ecological Life-support Systems



Biodiversity and protected areas

Percentage of strictly protected area in Canada has increased: up 70% since 1992

Total and strictly protected land in Canada (percent)



Data source: Canadian Council on Ecological Areas Database; Canadian Wildlife Service, Environment Canada.
Adapted by: National Indicators and Reporting Office, Environment Canada.

Meter Calculation

Trend in strictly protected areas between 1992 and 2001

Strictly protected areas are equivalent to the World Conservation Union (IUCN) classes I–III and exclude human activities such as forestry, mining, and agriculture. Total protected areas include IUCN classes IV–VI, where some or all of these activities are permitted, and includes migratory bird sanctuaries.

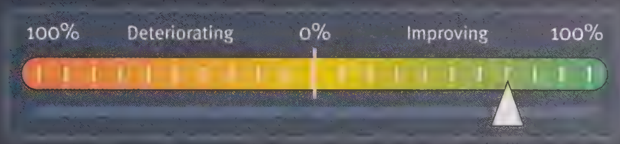
Context

Biodiversity, or biological diversity, refers to the variability among living organisms. It includes diversity within species (*genetic diversity*), between species (*species diversity*), and of ecosystems (*ecosystem diversity*). Biodiversity is important for its intrinsic value, but also for the priceless ecosystem services that it provides, such as clean water, clean air, maintenance of critical nutrient cycles, flood control, pest control, pollination of crops, compounds for new medicines, and seeds for new crops.

Canada is home to about 71 500 known species of wild animals, plants, and other organisms, and an estimated 66 000 species may yet be discovered. Canada is also steward of many globally important ecosystems on which species depend, such as 25% of the world's wetlands and boreal forests. Human well-being is tightly linked to the biodiversity on which all life depends. Loss of species or change in species composition can threaten ecosystem health and pose risks to economic and sociocultural sustainability.

Indicators

The amount of strictly protected area in Canada has increased from over 36 million hectares in 1992 to over 61 million hectares in 2001. Protected areas have emerged as a key tool in efforts to preserve biodiversity. Although significant progress has been made since 1992, there is still much work to be done. Currently, just over 6% of Canada's land is considered strictly protected under the World Conservation Union's classification system (IUCN I–III), and just over 10% has some level of protection (IUCN I–VI). Fourteen of Canada's protected



areas are very large — greater than 10 000 square kilometres (e.g., the 38 006-square-kilometre Quttinirpaaq National Park on Ellesmere Island which was established in 1999. However, 64% are smaller than 10 square kilometres. Small protected areas have a role to play in a protected areas network, often providing critical habitat for rare species requiring specialized habitats. However, many of Canada's large mammals need large home ranges (e.g., 150–250 square kilometres for Canada lynx and over 175 square kilometres for wolverine). Of the 194 terrestrial ecoregions of Canada, 113 have some strictly protected area, leaving 81 ecoregions with little or no protection.

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) has been identifying and monitoring Canadian species at risk since it was established in 1978. As of May 2002, 402 Canadian species were listed as being at risk. COSEWIC has assessed the status of many species on the list more than once. During the period 1985–2002, the status of half of the reassessed species remained unchanged, a third deteriorated, and 16% improved. The places in Canada with the most endangered or threatened species are those where humans have had the greatest impact on the environment.

As a result of commitments made in the 1996 Accord for the Protection of Species at Risk, the federal government and the provinces and territories have begun to

The status of most reassessed species at risk has either not changed or worsened

Change in status of reassessed species at risk, 1985–2002 (number of species reassessed)

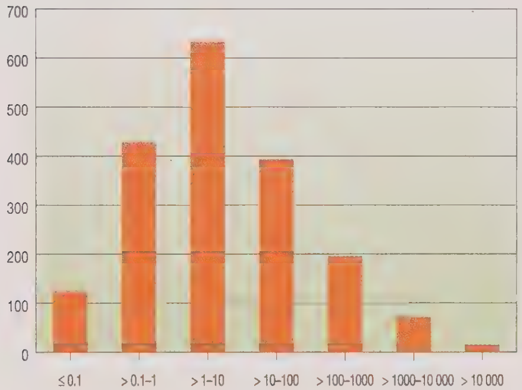
Data source: Committee on the Status of Endangered Wildlife in Canada (COSEWIC).
Adapted by: National Indicators and Reporting Office, Environment Canada.

Notes:

1. The data are based on status reassessments conducted by COSEWIC. Re-assessments based on existing status reports only were not included. These were re-evaluated using new IUCN criteria and not based on any new information.
2. Some downlistings and delistings were as a result of new information gathered rather than a change in the status of the species
3. Species reassessments that result in splitting a species into smaller units (i.e. populations) are considered new assessments.

Most protected sites in Canada are under 10 square kilometres

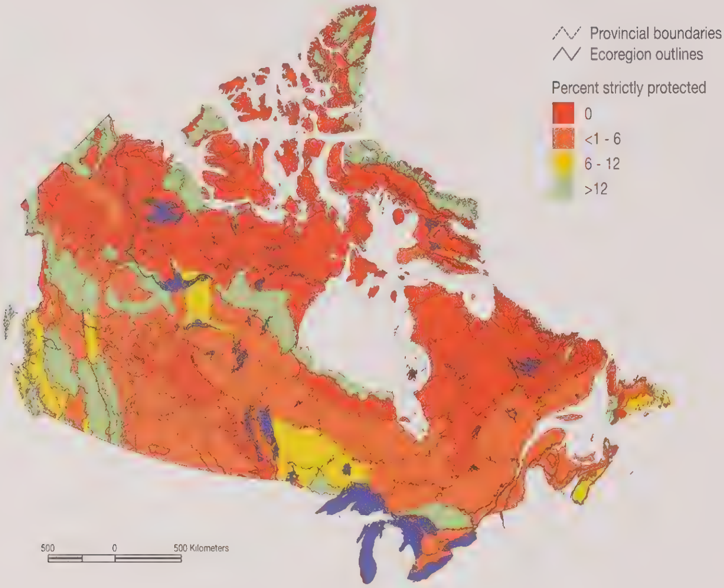
Number of strictly protected sites in Canada in each size range (square kilometres)



Data source: Canadian Council on Ecological Areas Database; Canadian Wildlife Service, Environment Canada.
Adapted by: National Indicators and Reporting Office, Environment Canada.

Over 40% of Canada's ecoregions have no strictly protected area

Strictly protected ecoregions in Canada, 2001



Data source: Canadian Council on Ecological Areas Database, Canadian Wildlife Service, Environment Canada.
Adapted by: National Indicators and Reporting Office, Environment Canada.

The surface of Canada is classified into ecologically distinct areas. From the broadest to the smallest these are: ecozones, ecoprovinces, ecoregions, ecodistricts, ecosections, ecosites and ecoelements.

assess the status of all species in Canada across their Canadian range. The broader assessment of all species provides a complement and context for COSEWIC's listings of species at risk.

Actions

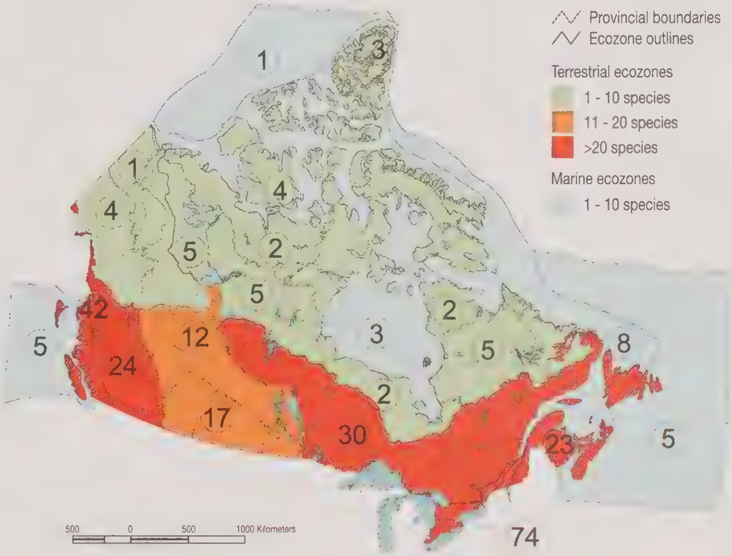
Canada has participated in the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) since its inception in 1975. Canada ratified the United Nations Convention on Biological Diversity in 1992 and went on in 1996 to complete the Canadian Biodiversity Strategy as a guide for implementing the Convention in Canada. Four priorities for the implementation of the strategy are science, monitoring, invasive alien species, and stewardship. An essential element of promoting biodiversity is the protection of vulnerable species and their habitats. Implementation of the National Strategy for Species at Risk requires further advancement of three components: the 1996 Federal-Provincial-Territorial Accord for the Protection of Species at Risk, the Canadian Species at Risk Act (SARA), and the Habitat Stewardship Program. Ratified in 2002, SARA protects wildlife species listed as being "at risk"

nationally as well as their critical habitats. The continued construction of the Canadian Biodiversity Information Network will assist in bringing together biodiversity information from a wide variety of sources and will highlight the need for accurate species inventories in Canada. The Recovery of Nationally Endangered Wildlife (RENEW) program is a federal–provincial–territorial program that provides for the development of recovery plans for species at risk. Of 118 endangered, 94 threatened, and 17 extirpated species on the November 2001 COSEWIC list, 83 have recovery teams in place, 14 have final recovery plans or strategies, 68 have recovery plans or strategies in development, 85 have species specific recovery work underway, and 42 are included in ecosystem recovery efforts. The North American Waterfowl Management Plan (NAWMP) is an international action plan between Canada, the United States (1986), and Mexico (1994) to conserve migratory birds throughout the continent. The Plan's goal is to restore the waterfowl populations to 1970s levels by conserving wetland and upland habitat.

Linkages

Loss of habitat has been identified as the key threat to biodiversity in Canada. However, other threats also play a role. All of the environmental stresses that affect human and ecosystem health, such as acid rain, water and air pollution, severe weather events, and climate change, also place biodiversity at risk. Habitat is threatened directly by some industrial activity, conversion of wildlands to other uses, and secondary effects of road access.

Number of endangered and threatened species, subspecies, and populations in each of Canada's ecozones, May 2001



Data source: Species at Risk Branch, Canadian Wildlife Service, Environment Canada.
Adapted by: National Indicators and Reporting Office, Environment Canada.

Challenges

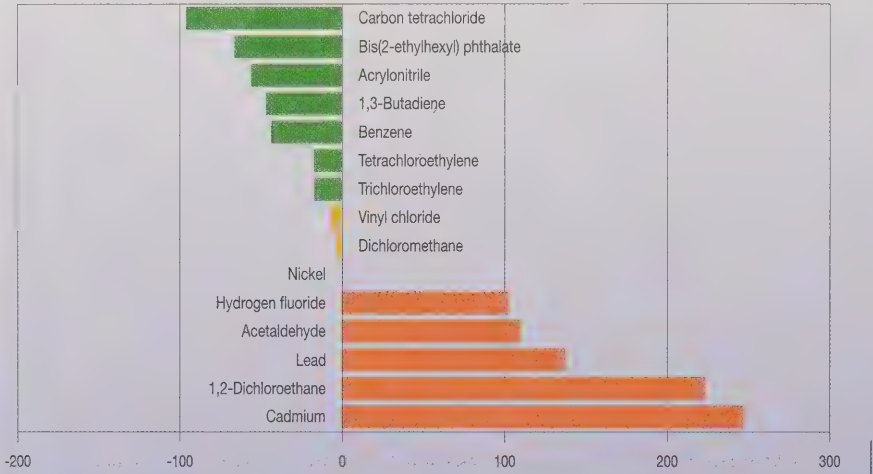
Canada does not have a reliable baseline against which to measure habitat loss. The National Round Table on the Environment and the Economy has identified a need to track changes in land use and land cover in Canada — a large and daunting task that would involve many agencies and levels of government. More scientific knowledge is needed about the impacts of human activities on ecosystem processes and particularly the thresholds beyond which ecosystems lose their ability to provide essential eco-system services. Little is known about most of Canada's species. In many cases, the status of species is at best an educated guess. A better inventory of the ranges of species, as well as their population sizes and trends, would help in creating a reliable assessment of the status of biodiversity in Canada. Biodiversity is a complex issue that requires a broad knowledge of ecological systems to be fully understood. Better tools are needed to provide a clear picture of biodiversity for the general public and non-technical policy-making audience. Finally, the information on which assessments of biodiversity are based is dispersed around the country, in academic, government, and industry databases. Easy and open access to this information would provide a variety of Canadians with the ability to assess biodiversity around the country.

Notes

Toxic substances

Change in emissions of toxic substances variable

Percent change in emissions of 15 CEPA toxic substances with matched data from 1995 to 2000



Data source: National Pollutant Release Inventory, Environment Canada.

Adapted by: National Indicators and Reporting Office, Environment Canada.

Meter Calculation

At this time it is not possible to have a comprehensive meter that adequately depicts risks from toxic substances.

Context

Approximately 23000 existing substances currently approved for use in Canada are being reviewed to determine if they are toxic or capable of becoming toxic. New substances, which include chemicals, polymers, and products of biotechnology, are assessed before their release into the marketplace. Fifty-two of these substances are defined as toxic by the *Canadian Environmental Protection Act, 1999* (CEPA 1999). A substance is toxic if it enters the environment in a quantity that has or may have a harmful effect on the environment or human health. Toxic substances come from many industrial and household sources. These substances can be harmful to the environment, aquatic life, endangered species, and human health.

Certain substances, such as mercury, DDE (breakdown product of DDT), and PCBs, build up in organisms over time, become increasingly concentrated *(bioaccumulation)*, and have a stronger toxic effect as they move through the food chain *(biomagnification)*.

Indicators

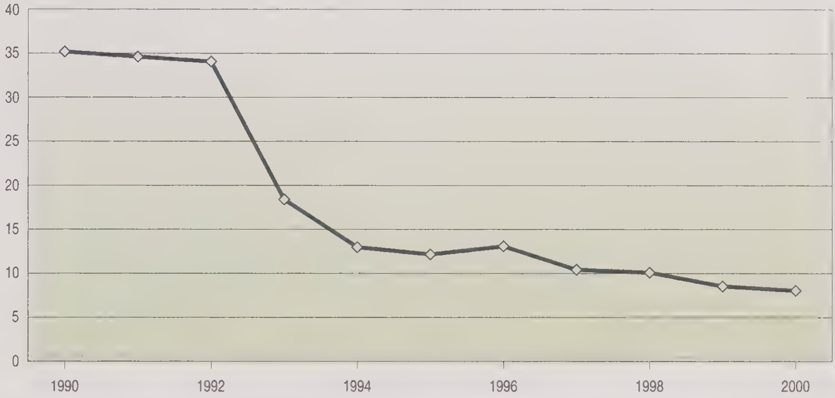
The first step in managing risk from toxic substances is recognizing that risk. The number of substances on the CEPA List of Toxic Substances has grown as progress has been made in assessing existing and new substances. When CEPA was first passed in 1988, there were 9 substances on the List. In 2002, there are 52. Once a sub-

stance is placed on the list, management strategies are developed and implemented to control its release into the environment.

The National Pollutant Release Inventory (NPRI) provides information on the releases and transfers of key pollutants to air, water and land from large industrial and commercial sources in Canada. Only facilities that meet the NPRI reporting criteria are required to report. Mobile sources (e.g. trucks and cars), households, certain sector activities such as agriculture and education and facilities that release pollutants on a smaller scale are not reflected in the NPRI. The list of substances reportable to the NPRI changes from year to year. For example, the list may change due to the addition of new substances, deletion of others and changes in the release or transfer thresholds/levels. To compensate for these changes, a set of "matched data" is used for trend analysis. The matched data refers to the common set of substances and reporting criteria, which can then be used for

Atmospheric emissions of mercury are decreasing

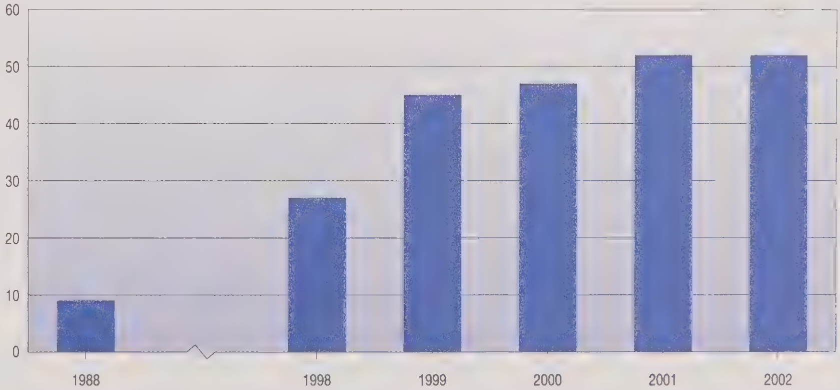
Canadian atmospheric emissions of mercury (thousands of kilograms)



Data source: Comprehensive Mercury Inventory, Environment Canada.
Adapted by: National Indicators and Reporting Office, Environment Canada

Number of toxic substances listed on schedule 1 is increasing

Substances identified as toxic – listed on schedule 1 under CEPA (number of substances)



Data source: National Office of Pollution Prevention, Environment Canada.
Adapted by: National Indicators and Reporting Office, Environment Canada.

The decline in concentrations of toxic contaminants in cormorant eggs has slowed

Contaminant levels in Double-crested Cormorant eggs (parts per million)

Data source: Canadian Wildlife Service, Environment Canada.

Adapted by: National Indicators and Reporting Office, Environment Canada.

DDE

Dichlorodiphenyldichloroethylene is the main breakdown product of the pesticide dichlorodiphenyl-trichloroethane, DDT.

PCBs

Polychlorinated biphenyls are industrial chemicals.

comparisons over a specific period of time. Reliable matched data from 1995 to 2000 are available for 15 toxic substances. Of the 15, on-site releases have decreased for 7, changed little for 3, and increased for 5.

There has been important progress made towards reducing emissions of a number of toxic substances. For example, mercury emissions to air saw an overall decrease of 77% from 1990 to 2000. Emissions were reduced primarily from incineration operations as well as the steel and primary base metals sectors. Emissions from electric power generators increased over this time period.

The concentrations of persistent organic pollutants (POPs), such as DDE and PCBs, in wildlife vary considerably among individual animals as well as among locations across the country. However, contaminant concentrations in the eggs of Double-crested Cormorants have declined since the early 1970s, with most gains made before 1990. Scientists suspect that the lack of further concentration declines, despite the banning of these chemicals in Canada, may result from long-range transport, the slow release of contaminant residues from bottom sediments, and, in the case of PCBs, the release of PCBs from storage and dump sites as well as products still in use.

Actions

Through CEPA 1999, the Government of Canada seeks to protect the environment and human health from the risks posed by toxic substances. CEPA includes effective and flexible provisions for preventing pollution, controlling toxic substances, managing wastes, and preventing and addressing environmental emergencies. The Act provides clear objectives for assessing new and existing substances and managing risks through a wide range of measures, including codes of practice, guidelines, pollution prevention plans, economic instruments, and regulations. Efforts are also made to promote early action through complementary voluntary initiatives, such as the Accelerated Reduction/Elimination of Toxics (ARET) program.

A Canada-wide standard (CWS) for mercury for coal-fired electricity generators is being developed to help address the issue of increased generator emissions. A phased approach to further emission reductions of benzene has also been endorsed through the CWS process. The *Benzene in Gasoline Regulations* set limits for the amount of benzene in gasoline and for a benzene emissions factor.

In the past decade, Canada has developed the Toxic Substances Research Initiative, as well as the *Toxic Substances Management Policy*, which sets out two tracks for the management of toxic substances: virtual elimination and life cycle management. The NPRI provides Canadians with access to information on key sources of pollution in their communities. The National Air Pollution Surveillance (NAPS) program collects data on the components of smog, and can help identify links between air pollution and human health. The Northern Contaminants Program, established in 1991, is directed at reducing or eliminating contaminants in high-risk foods harvested in Canada's North.

Canada was the first nation to ratify the Stockholm Convention on Persistent Organic Pollutants, which identifies problematic substances for which comprehensive global action is required. Canada has also developed trilateral action plans with Mexico and the United States on chlordane, DDT, and PCBs under the Commission on Environmental Cooperation, an organization created under the North American Agreement on Environmental Cooperation. This agreement complements the environmental provisions of the North American Free Trade Agreement.

Linkages

Other chemicals of concern, because of their potential toxic effects on the environment and human health, are heavy metals for which trends were not available and pesticides. Certain water quality indicators may predict levels of chemical contaminants in wildlife over time. Toxic compounds in wildlife are used as an early warning signal for effects on human health and ecosystems. For example, contaminants in marine mammal tissue provides a measure of the health of marine ecosystems; contaminants in polar bear tissue provides a measure of the health of northern ecosystems. Climate change and increased ultraviolet B radiation may affect the behaviour of toxic substances in the environment.

Challenges

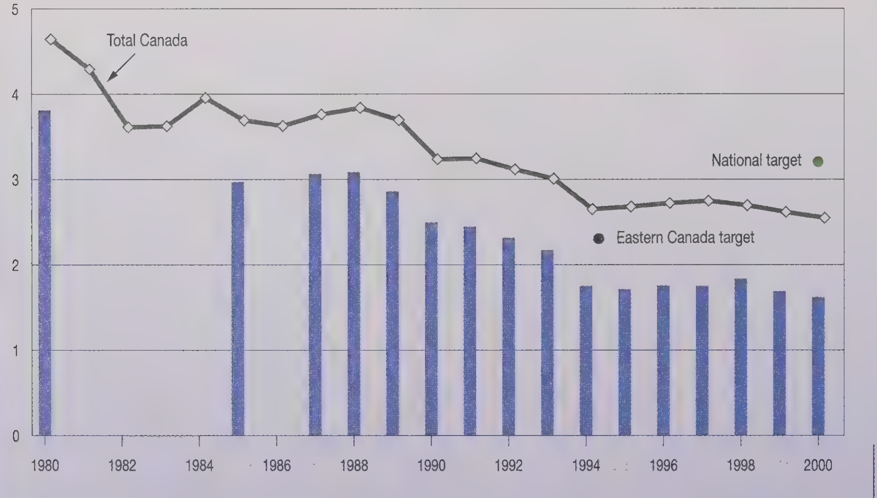
More work must be done to understand and limit the risks posed by the thousands of chemicals released into the environment annually. Governments, industry, and communities have to work together to address this challenge. Progress continues towards meeting the challenge of categorizing the approximately 23000 substances in use in Canada by September 2006. New scientific and technological developments offer not only opportunities, but also new and complex risks to the health and environment of Canadians. An increased awareness of the importance of prevention will be crucial in dealing with these risks.

Notes

Acid rain

The decline in sulphur dioxide emissions has slowed but emissions are still under current targets. Emissions are down 19% since 1991.

Sulphur dioxide emissions for Eastern Canada (million tonnes)



Data source: Criteria Air Contaminants Division, Environment Canada.
Adapted by: National Indicators and Reporting Office, Environment Canada.

METER CALCULATION

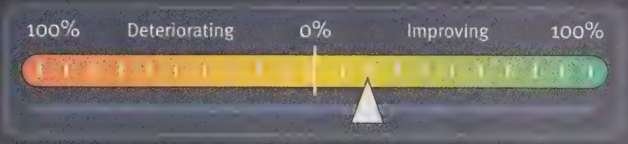
Trend in total emissions from 1991 to 2000

Context

Acid rain is caused by pollutants such as sulphur dioxide and nitrogen oxides, which are emitted into the atmosphere primarily as a result of human activity. These pollutants are then chemically converted to sulphuric and nitric acids. Dilute forms of these acids fall to the Earth as rain, hail, drizzle, freezing rain, or snow (*wet deposition*) or are deposited as acid gas or particles (*dry deposition*). Eastern Canada receives the most acid deposition, posing a particular problem because of the generally poor ability of soils in this region to neutralize the acid. Acid deposition has many adverse effects on ecosystems. It can slow tree growth and kill trees by acidifying the soil from which the roots get their nutrients. It can also acidify sensitive lakes, rivers, and streams and cause metals to leach from surrounding soils into the water system. These conditions may impair aquatic ecosystems and alter species composition. As well, acid deposition deteriorates some building materials and poses a risk to some historic structures. Human exposure to particulate matter, including sulphate and acidic aerosols, may result in respiratory disorders.

Indicators

By 2000, Canada's sulphur dioxide emissions were 45% lower than the 1980 level and 20% below the national target set for 2000 onward. Similarly, eastern Canadian emissions of sulphur dioxide were approximately 30% below the cap for this part of the country. Canadian nitrogen oxide emissions, however, have increased slightly since the early 1980s and have remained at



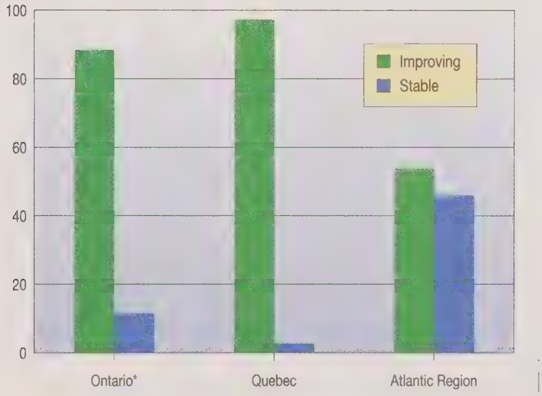
Nitrogen oxide emissions remain steady

Nitrogen oxide emissions in Canada (million tonnes)

Data source: Criteria Air Contaminants Division, Environment Canada.
Adapted by: National Indicators and Reporting Office, Environment Canada.

Sulphate levels improving or stable in all lakes

Trends in lake sulphate levels 1981–1997
(percentage of number of lakes studied)

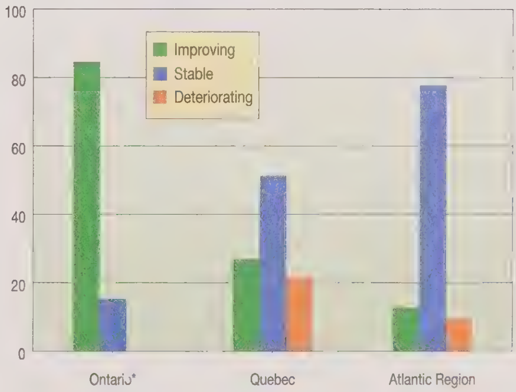


Data sources: Ontario, Atlantic, and Quebec regions, Environment Canada.
Adapted by: National Indicators and Reporting Office, Environment Canada.

* 73% of lakes studied in Ontario are in the Sudbury region.

Lake acidity still deteriorating in some lakes

Trends in lake acidity 1981–1997
(percentage of number of lakes studied)



Data sources: Ontario, Atlantic, and Quebec regions, Environment Canada.
Adapted by: National Indicators and Reporting Office, Environment Canada.

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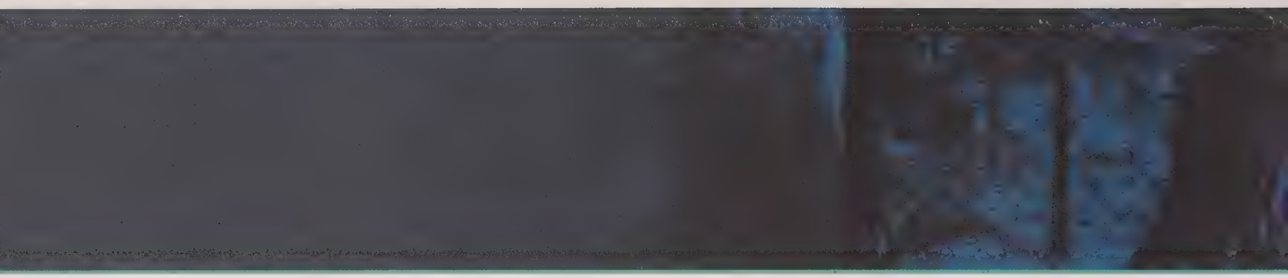
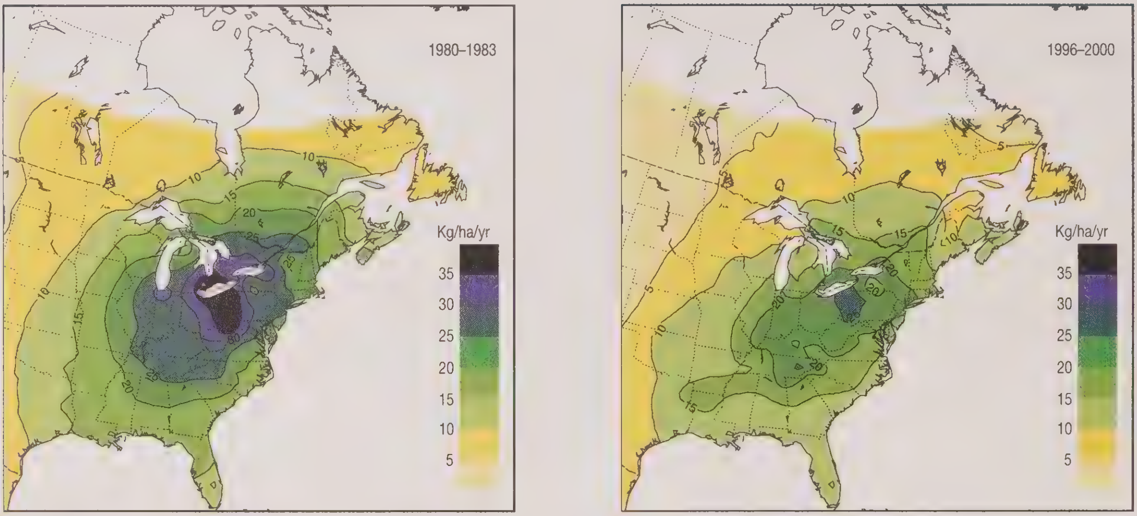


Wet sulphate deposition down since 1980s

Wet sulphate deposition four-year mean (kilograms/hectare per year)



Source: Canadian National Atmospheric Chemistry Database, Meteorological Service of Canada, Environment Canada.

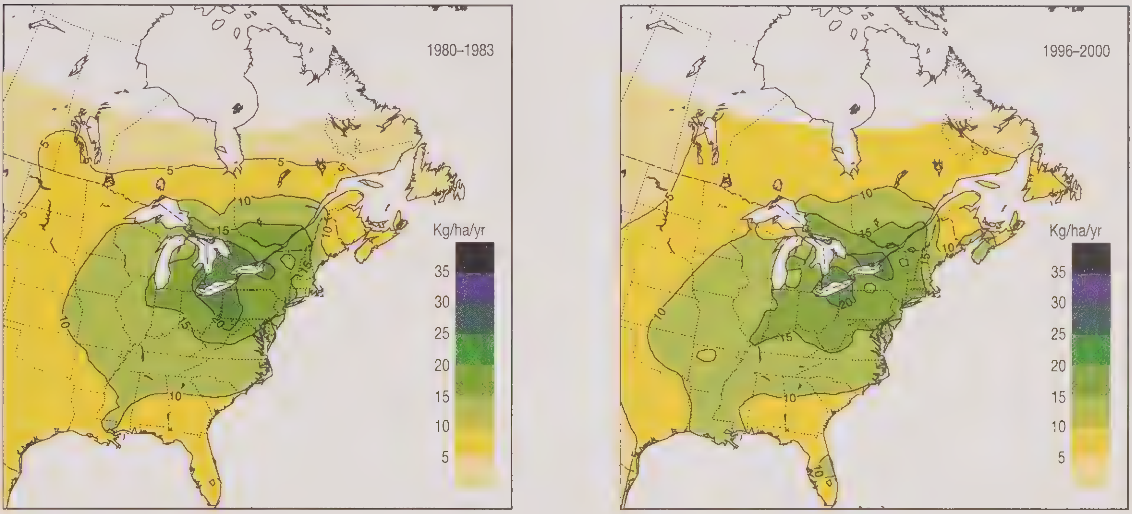
approximately 2 million tonnes since 1991. The area in eastern Canada annually receiving 20 kilograms or more of wet sulphate per hectare shrank considerably between the two periods 1980–1983 and 1996–2000. At the same time, the pattern of wet nitrate deposition changed very little. Of 152 lakes monitored for the effects of acid rain in Ontario (mostly in the Sudbury region), Quebec, and the Atlantic Region since the early 1980s, 41% have showed some improvement in acidity levels, 50% have showed no change, and 9% have become worse. Lake sulphate levels, which have shown considerably more improvement than acidity levels, respond to reductions in sulphur dioxide emissions. However, a time lag of many years is required before this translates into widespread regional improvements in lake acidity or alkalinity.

Actions

The Canadian Acid Rain Program, involving the governments of Canada and the seven eastern provinces, was established in 1985 with the goal of reducing sulphur dioxide emissions to 40% below 1980 levels by 1994. It was hoped that this action would reduce the deposition of sulphates in eastern Canada to below the 20 kilograms per hectare per year critical load for protecting moderately sensitive ecosystems. Due to improved understanding of the effects of acid rain, the critical load levels have since been re-evaluated and lowered, depending on the sensitivity of the area. Further action against acid rain depended on the cooperation of the United States, the source of about half the acid rain in eastern Canada. In 1991, Canada and the United States entered into the

Area receiving more than 20 kilograms/hectare per year of wet nitrate deposition shows little change since the 1980s

Wet nitrate deposition four-year mean (kilograms/hectare per year)



Source: Canadian National Atmospheric Chemistry Database, Meteorological Service of Canada, Environment Canada.

Canada–U.S. Air Quality Agreement to further reduce sulphur dioxide and nitrogen oxide emissions. Canada agreed to a permanent national limit of 3.2 million tonnes per year for sulphur dioxide emissions and a 10% reduction in projected nitrogen oxide emissions, both by 2000. In October 1998, federal, provincial, and territorial energy and environment ministers signed the Canada-wide Acid Rain Strategy for Post 2000, aimed at creating new sulphur dioxide emission reduction targets for some provinces. Under the strategy, Ontario, Quebec, New Brunswick and Nova Scotia have committed to additional sulphur dioxide emission cuts of 50% beyond established caps. Several provinces are developing emission reduction targets for nitrogen oxides; at present, however, only Ontario has set an emission target.

Linkages

Acid rain is linked to energy consumption, particularly the combustion of fossil fuels. Transportation is a leading consumer of fossil fuels and a significant source of nitrogen oxide emissions, so improvements in fuel efficiency and composition and alternative fuel use can be expected to contribute to reductions in acid rain. Because nitrogen oxide emissions contribute to ground-level ozone, a key ingredient in smog, a reduction in these emissions would help to improve air quality. Acid rain affects aquatic and forest ecosystems, impairing ecosystem health and productivity and reducing biodiversity. Particulate sulphate in smog poses a risk to human health.

Challenges

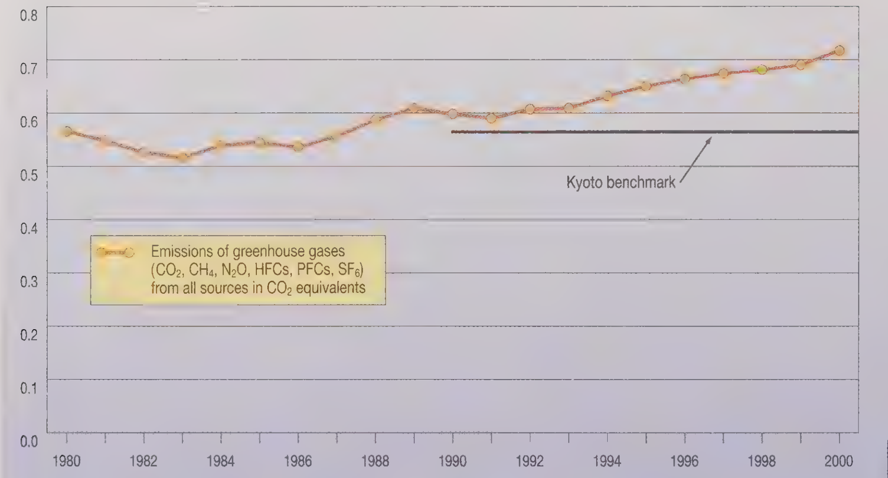
The effects of acid rain on fish, wildlife, and plants are not well known. Lake sensitivity is proving greater than initially thought, and an estimated 800 000 square kilometres, extending from central Ontario through southern Quebec and across much of Atlantic Canada, will continue to receive sulphate deposition that impairs ecosystems, even after current Canadian and U.S. control programs are fully implemented. Scientists estimate that a further 75% reduction in sulphur dioxide emissions beyond current commitments is needed in targeted regions. Although sulphur dioxide has been well studied, nitrogen oxide deposition is still not well understood, highlighting the need for more monitoring and a review of critical loadings. If nitrate deposition continues at present levels, its contribution to acidification could eventually erode the benefits gained from the reductions in sulphur dioxide emissions. Acid deposition, lake temperature, and increased ultraviolet radiation exposure caused by stratospheric ozone depletion interact in complex ways to affect aquatic life, emphasizing the importance of taking action on multiple issues simultaneously.

Notes

Climate change

Canadian Greenhouse gas emissions up 20% since 1990

Canadian greenhouse gas emissions (gigatonnes)



Data source: Greenhouse Gas Division, Environment Canada.

Adapted by: National Indicators and Reporting Office, Environment Canada.

Meter Calculation

Percent change in greenhouse gas emissions between 1990 and 2000

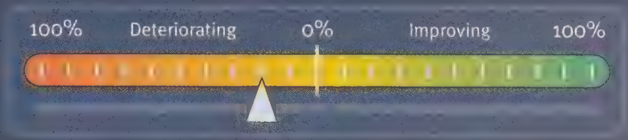
Gigatonnes: 10^9 tonnes
CO_2: carbon dioxide
CH_4: methane
N_2O: nitrous oxide
HFCs: hydrofluorocarbons
PFCs: perfluorocarbons
SF_6: sulphur hexafluoride

Context

A small group of greenhouse gases — mainly carbon dioxide, methane, nitrous oxide, and water vapour — help to regulate the Earth's climate by trapping solar energy that reradiates from the Earth's surface as heat. Emissions from human activities enhance this natural process. Since industrialization, human activities such as burning fossil fuels have increased the amount of greenhouse gases emitted into the atmosphere. It is widely believed that increased emissions have enhanced the greenhouse effect, causing the atmosphere to warm and the climate to change. While overall global temperatures are increasing, regional climates each change differently, and some have experienced a cooling trend. Climate change is expected to affect human health (through, for example, increases in asthma, heat stress, and disease transmission), traditional Aboriginal ways of life, air quality (especially smog levels), the hydrologic cycle and water availability (e.g., precipitation, stream flow, sea level, ice, snow, and glaciers), severe weather events, terrestrial and aquatic habitat, agricultural range and practice, and overall national productivity.

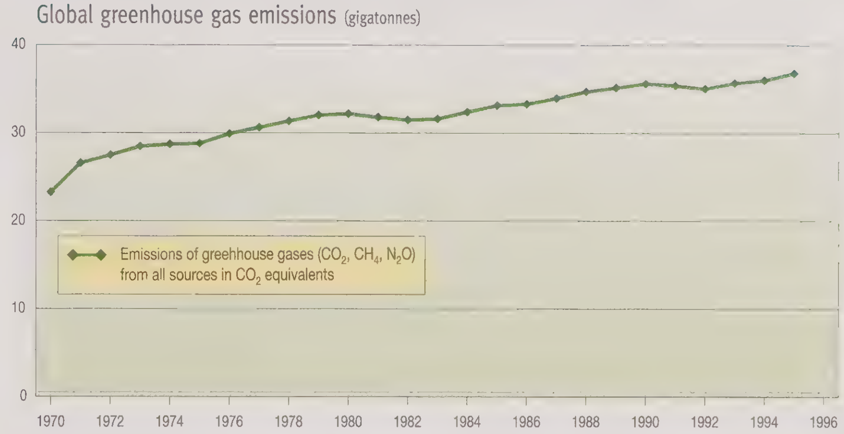
Indicators

Globally, carbon dioxide emissions from energy use have quadrupled since 1950. In 1998, Canada's share of these emissions was approximately 2%. Canadian emissions of six key greenhouse gases have grown 20% since 1990. Increased emissions of carbon dioxide are reflected in global atmospheric carbon dioxide concentrations, which have increased by 33% since the beginning of the industrial age. Since carbon dioxide is a well-mixed gas in the atmosphere, measurements made at any place on



the globe are considered representative. The average global temperature has risen by about 0.6°C over the past century, with Canada's average temperature rising about 1°C between 1950 and 2000. While there is no conclusive scientific evidence supporting a link between weather extremes and greenhouse-gas-induced climate change, there is little debate that Canadians have experienced recent changes in weather patterns and a substantial increase in the number of weather-related disasters.

Global greenhouse gas emissions continue to increase



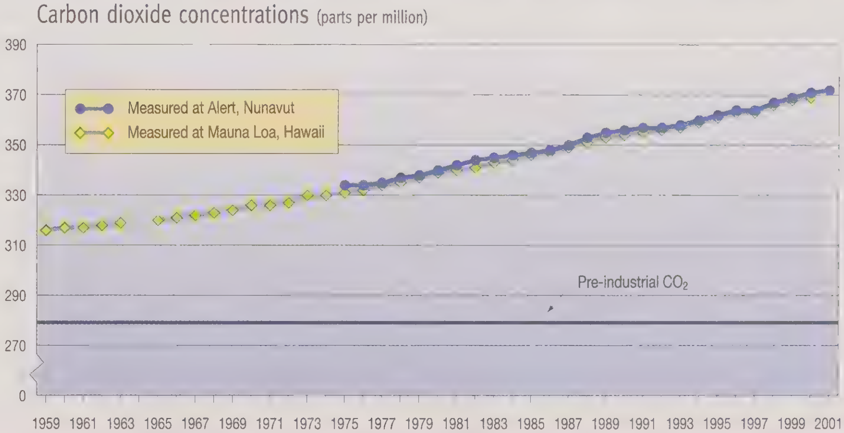
Data sources: Emissions database for Global Atmospheric Research, The Netherlands.
Adapted by: National Indicators and Reporting Office, Environment Canada.

Actions

In 1992, Canada ratified the United Nations Framework Convention on Climate Change, which set out a framework for action to limit emissions of greenhouse gases. In 2002, Canada ratified the Kyoto Protocol to the Convention, committing to reduce its greenhouse gas emissions to 6% below 1990 levels by 2008-2012.

Current programs and policies of the Government of Canada will reduce greenhouse gas emissions by 80 megatonnes by 2008-2012. This includes

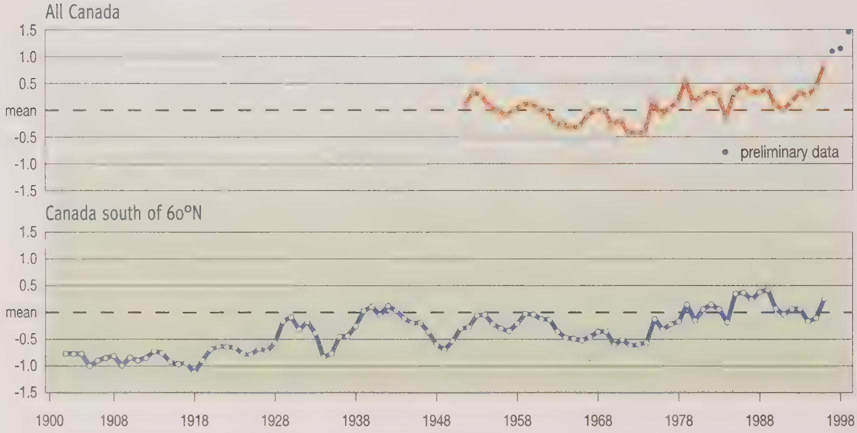
Global atmospheric concentrations of carbon dioxide on the rise



Data sources: Meteorological Service of Canada, Environment Canada: Carbon Cycle Group, National Oceanic and Atmospheric Administration, USA.
Adapted by: National Indicators and Reporting Office, Environment Canada.

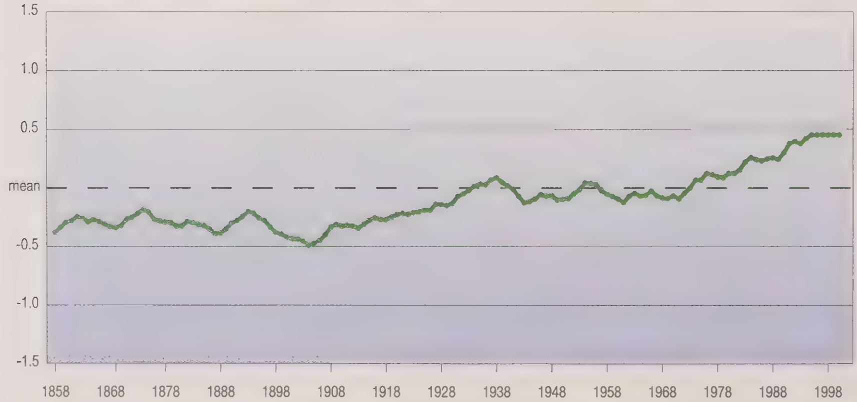
Average Canadian and global temperatures are rising

Change in Canadian temperatures (°C) from 1961–1990 mean (five-year averages)



Data source: Climate Research Branch, Meteorological Service of Canada, Environment Canada.
Adapted by: National Indicators and Reporting Office, Environment Canada.

Change in global temperatures (°C) from 1961–1990 mean (five-year averages)



Data source: Climatic Research Unit, University of East Anglia, UK.
Adapted by: National Indicators and Reporting Office, Environment Canada.

estimated sink credits from improvements in agricultural and forest management practices that remove and store carbon from the air. These reductions amount to almost one-third of the Kyoto target. In 2002, the Government announced a strategy for a further 100 megatonne reduction and outlined a number of current and potential actions that should enable Canada to address the remaining 60 megatonne reduction. These programs lay the groundwork for long-term behavioural, technological, and economic change and give individual Canadians the tools that they need to do their part. The public education and outreach component of the Climate Change Action Fund (CCAF) builds awareness and understanding and provides Canadians with the information necessary to take responsible action to reduce greenhouse gas emissions. Other CCAF programs are directed at the residential, commercial, industrial and transportation sectors and include funding for science as well as early actions to reduce emissions and increase understanding of impacts and adaptation in the public and private sectors.

Linkages

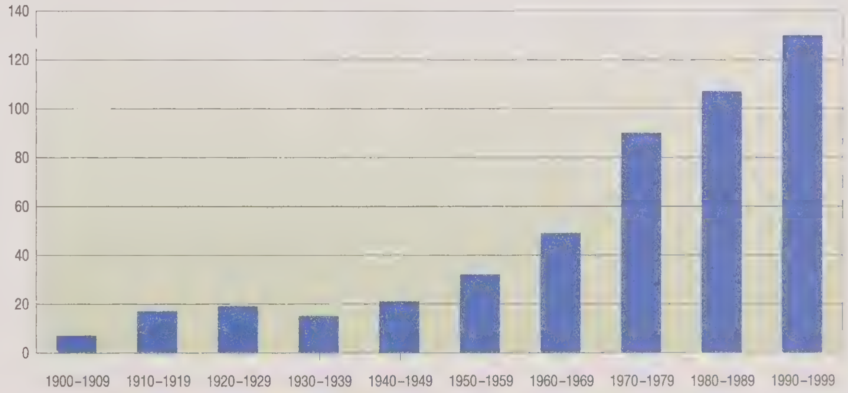
Climate change is linked to stratospheric ozone depletion, primarily because the most important ozone-depleting substances (chlorofluorocarbons, hydrochlorofluorocarbons) are also powerful greenhouse gases and because ozone itself is a greenhouse gas. Actions taken to reduce greenhouse gas emissions will also contribute to improved air quality, since the burning of fossil fuels creates both greenhouse gases and gases that cause air pollution. Transportation indicators can be linked directly to climate change, given the dependence of transportation on fossil fuels. Greenhouse gas emissions are also related to the type of land use, since the amount of forested land and land under intense agriculture affects the amount of sources and sinks of greenhouse gases. Agriculture and Agri-Food Canada tracks the contribution of agricultural production to greenhouse gas emissions and the potential for agricultural soils to act as a carbon sink and thus offset carbon dioxide emissions. The Canadian Council of Forest Ministers is tracking ways in which forests can help mitigate climate change through the use of indicators related to forest sector carbon dioxide conservation and forest ecosystem contributions to the global carbon budget. Adjusting land use patterns to encourage more forests, other plant cover, and soils to act as carbon sinks will have the added benefit of setting aside wildlife habitat and restive natural landscapes. Energy production is mostly done through the combustion of fossil fuels, resulting in greenhouse gas emissions; therefore, indicators of energy efficiency are strongly linked to the issue of climate change.

Challenges

Anticipated climate change is a very serious concern for Canada and the world. We are only now beginning to see the results of long-term processes that will continue for centuries to come. Changing the habits of individuals across the globe will require strong leadership and commitment in order to adequately curb emissions and adapt to climate change. There is also a need to start tracking what our response has been to the issue in order to determine which programs have been successful or show the most promise. A greater understanding of the effects of global climate change on regional and local environmental systems is needed to help determine appropriate mitigation and adaptation strategies.

Number of weather-related disasters in Canada increasing

Number of weather-related disasters in Canada, 1900–1999



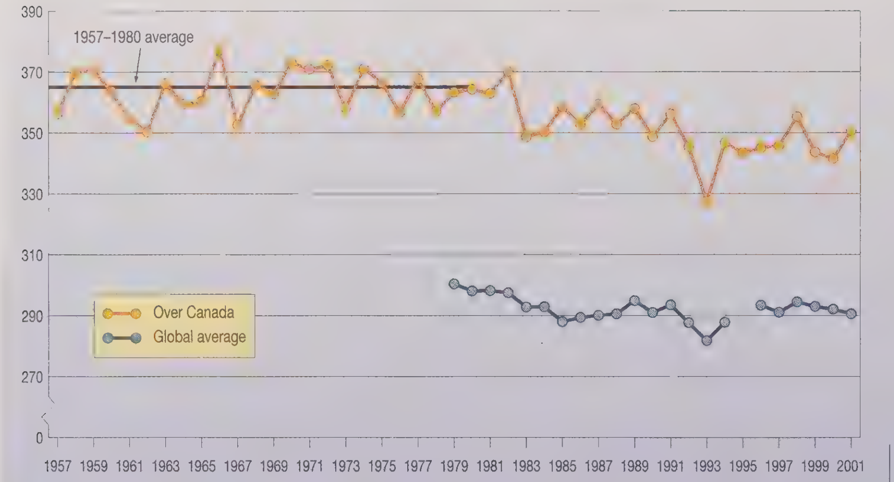
Data source: Emergency Preparedness Canada.

Adapted by: National Indicators and Reporting Office, Environment Canada.

Stratospheric ozone

Stratospheric ozone levels not yet recovering

Average annual ozone levels (Dobson units)



Data sources: Meteorological Service of Canada, Environment Canada; National Aeronautics and Space Administration, USA.

Adapted by: National Indicators and Reporting Office, Environment Canada.

Meter Calculation

Trend in Canadian values from 1990 to 2000

Dobson units

One Dobson unit is equivalent to a layer of pure ozone 0.01 mm thick at standard temperature (0°C) and pressure (101.3 kPa), spread over the surface of the Earth.

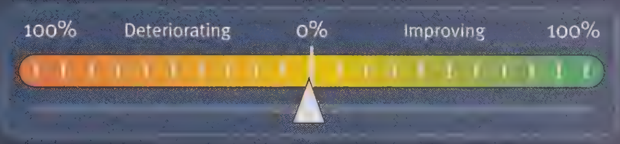
Context

Stratospheric ozone protects life on Earth by filtering out biologically harmful wavelengths of ultraviolet (UV) radiation emanating from the sun. The depletion of ozone in the upper atmosphere, commonly referred to as the thinning of the ozone layer, has resulted in increased mid-range UV-B radiation at the Earth's surface, a rise of 10% from 1986 to 1996 when globally averaged. Excessive exposure of humans to UV-B causes sunburn and DNA damage, which can lead to skin cancer, depression of the immune system, and an increased risk of cataracts. It is believed that a sustained 1% decrease in stratospheric ozone will result in a 2% increase in cases of non-melanoma skin cancer. The incidence of melanoma in Canada has doubled during the last 20 years.

The single largest factor in ozone depletion is the release of halocarbons, which include chlorofluorocarbons (CFCs), bromofluorocarbons, methyl chloroform, carbon tetrachloride, methyl bromide, and hydrochlorofluorocarbons (HCFCs). These ozone-depleting substances have been used in air conditioning and refrigeration equipment, foams, aerosols, and fire extinguishers and as solvents and pesticides. If atmospheric concentrations of these gases can be sufficiently reduced, it is hoped that natural processes will return ozone concentrations to pre-industrial-era levels.

Indicators

Since 1979, the annual average amount of stratospheric ozone has dropped globally by 3–6% per decade at mid-latitudes, 12% at high northern latitudes such as northern Canada, and 10–18% at far southern latitudes, such as



Antarctica. There has been a similar trend in the depletion of Canadian stratospheric ozone levels since 1980. While the extreme meteorological conditions of the Antarctic are unlikely to occur in the Canadian Arctic, the late-winter/spring ozone levels in the Arctic have been unusually low in six of the last nine years. Due to the long atmospheric lifetimes of ozone-depleting chemicals in the upper atmosphere, ozone levels are not expected to show signs of recovery until at least 2030 — a recovery that could be further slowed by climate change.

Global CFC production fell by 88% between 1988 and 1999. The global abundance of CFC-11 in the lower atmosphere peaked around 1994 and is now slowly declining, while the level of CFC-12 is still increasing very gradually. New supplies of ozone-depleting substances in Canada fell from a high of 27.8 kilotonnes in 1987 to about 1 kilotonne (composed mostly of HCFCs) in 2000. Annual new supplies of HCFCs are currently frozen at 1996 levels, and production will cease by 2022, except for small quantities used for servicing equipment and as laboratory standards.

Actions

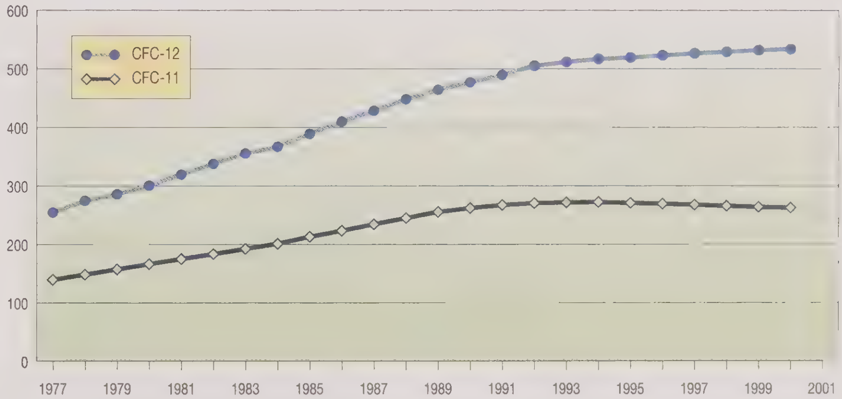
During the late 1980s, nations from around the world met to discuss the urgent need to protect the stratospheric ozone layer by reducing emissions of ozone-depleting substances. In 1989, the Montreal Protocol of the Vienna Convention for the Protection of the Ozone Layer was ratified, and today 183 countries have joined this agreement. Under the Montreal Protocol, all new supplies of ozone-depleting substances, except HCFCs and methyl bromide, were phased out by developed countries, including Canada, by January 1996. Methyl bromide will be phased out by 2005, and HCFCs by 2030.

Linkages

Ozone is a greenhouse gas as well as a UV filter. Thus, a loss of stratospheric ozone leads to cooling of the stratosphere. CFCs and HCFCs act as potent greenhouse gases. These gases trap heat within the lower atmosphere before it can reach the stratosphere. Both of these processes cause a cooling of the stratosphere, further contributing to the conditions that are conducive to ozone depletion.

Global atmospheric levels of ozone-depleting substances beginning to level off

Atmospheric concentrations of chlorofluorocarbons (CFCs) 11 and 12 (parts per trillion)



Data source: National Oceanic and Atmospheric Administration, USA.

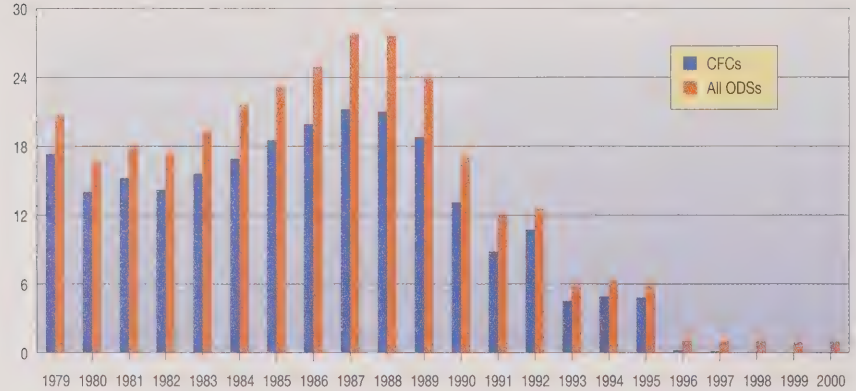
Adapted by: National Indicators and Reporting Office, Environment Canada.

Chlorofluorocarbons (CFCs)

CFCs are a group of organic chemicals consisting of carbon, chlorine, and fluorine. They are hydrocarbon derivatives where chlorine and fluorine partially or fully replace the hydrogen. CFC-11 and CFC-12 are the most abundant CFCs.

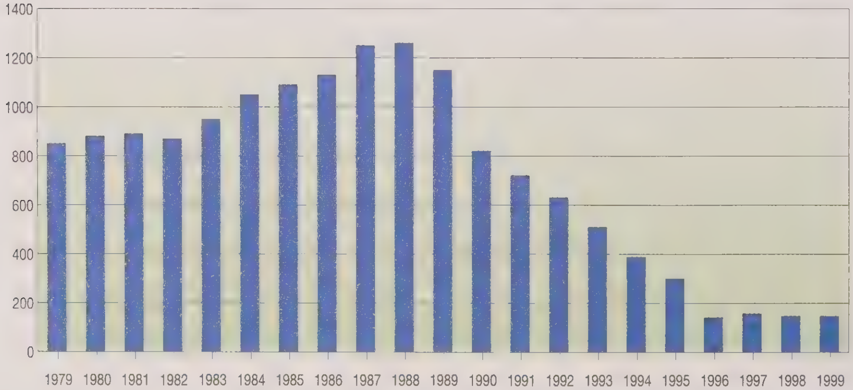
New supplies of ozone-depleting substances almost phased out

New supplies of ozone depleting substances (ODSs) in Canada
(kilotonnes, expressed as CFC-11 equivalent)



Data source: Use Patterns and Controls Implementation Section, Environment Canada.
Adapted by: National Indicators and Reporting Office, Environment Canada.

Global chlorofluorocarbon production (kilotonnes, expressed as CFC-11 equivalent)



Data source: National Aeronautics and Space Administration, USA.
Adapted by: National Indicators and Reporting Office, Environment Canada.

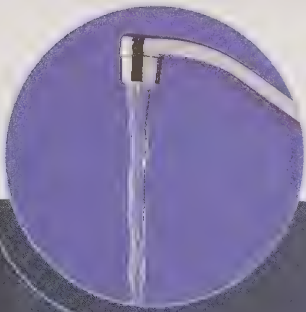
Increased UV-B levels also affect human health, reduce crop yields, and disrupt marine food chains. Some species may be so sensitive to UV-B (e.g., amphibians) that the additional stress on their populations could increase their risk of extinction.

Challenges

Although the lack of reporting by some countries and smuggling of ozone-depleting substances create uncertainties, significant progress has been made. Nonetheless, the ozone layer is still seriously damaged and has not yet begun to recover, and signs of recovery are not expected before 2030. Furthermore, recent findings are suggesting that by the 2030s, climate change may surpass CFCs as the main driver of overall ozone loss. Scientists continue to search for effective alternatives that do not deplete the ozone layer or act as greenhouse gases.

Notes

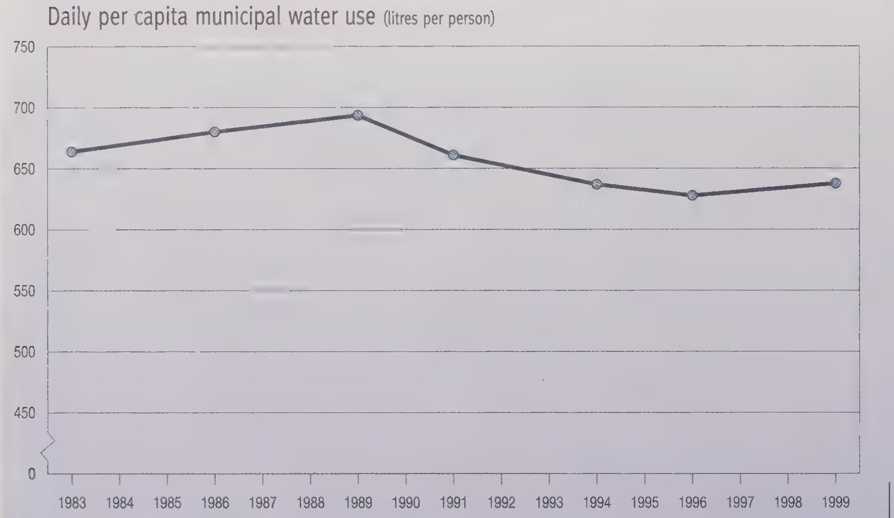




Human Health and Well-being


Municipal water use

Per capita water use has changed little: down 4% since 1991



Data source: Municipal Water Use Database, Environment Canada.

Adapted by: National Indicators and Reporting Office, Environment Canada.

Meter Calculation

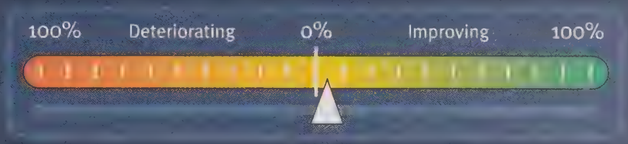
Percent change in per capita municipal water use between 1991 and 1999.

Context

Canadians are among the highest water users in the world, using roughly twice as much per person as in other industrialized countries, with the exception of the United States. Water in Canada is used for many purposes, including municipal use, agriculture, thermal power generation, manufacturing, and mining. Of all surface water and groundwater withdrawn in Canada, 11% is used by municipalities. High water use results in many different impacts, such as high costs for supplying drinking water, treating wastewater, and maintaining or upgrading infrastructure and changes in water levels and water quality, which have direct impacts on aquatic ecosystems, biodiversity, human health, and water shortages. From 1994 to 1999, about 26% of Canadian municipalities reported water shortages at one time or another as a result of drought, infrastructure problems, or growing consumption.

Indicators

Water used daily, per person, for all municipal sectors declined by 4% between 1991 and 1999. During this period, total daily municipal water use increased by 5%, largely reflecting the increase in municipal population. Residential water use accounts for more than half of all municipal water use. One of the key factors explaining high residential consumption rates is the lack of financial incentive to Canadian households to use less water. For instance, in 1999, unmetered households, which pay a flat rate for water, used 50% more water than metered households, which pay for water by volume used. About 57% of Canada's municipal population had water meters in 1999, showing a gradual increase since 1991.

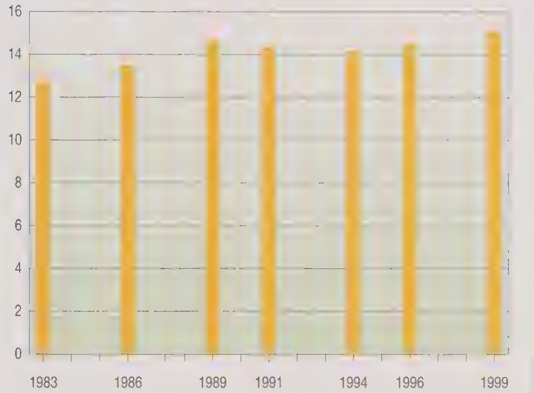


Actions

In 1994, the Canadian Council of Ministers of the Environment approved a National Action Plan to Encourage Municipal Water Use Efficiency. The plan guides governments and municipalities in ways to achieve greater water efficiencies and decrease capital expansion and operating costs. The Government of Canada has established a $200-million Green Municipal Investment Fund and a $50-million Green Municipal Enabling Fund, both administered by the Federation of Canadian Municipalities in support of environmental projects, including those that increase the environmental efficiency and cost effectiveness of existing municipal water and wastewater systems. In 2000, the federal government announced the Infrastructure Canada Program, which will invest $2.65 billion over six years to support green municipal infrastructure projects, including municipal water and wastewater treatment.

Total municipal water use increasing

Total daily municipal water use (billions of litres per day)



Data source: Municipal Water Use Database, Environment Canada.
Adapted by: National Indicators and Reporting Office, Environment Canada.

Linkages

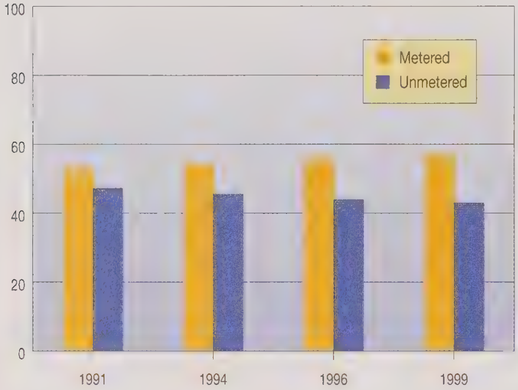
Reduced municipal water use decreases the need for increasing the capacity of water treatment infrastructure and lowers the energy needed to build and operate the infrastructure. Reduced municipal water use also renders wastewater treatment more efficient and reduces the need to increase the capacity of wastewater treatment infrastructure. Water use is linked to the issue of climate change, because global warming will result in some areas becoming more prone to drought and water shortages — a small increase in temperature will have an impact by causing a significant increase in water evaporation, even in areas expected to experience a slight increase in precipitation.

Challenges

Canadian municipal water prices are currently among the lowest in the world and cover roughly half the municipal costs of supplying water and treating wastewater. Many municipalities are lagging behind in upgrading water management plans and infrastructure. In the face of the growing need for water and the potential for conflict among users, Canada must find ways both to protect water quality and to use water more efficiently. Increasing the efficiency of water use will involve moving from traditional supply management to demand management, including applying higher water prices and pricing water

Percentage of municipal population with meters increasing slowly

Canadian municipal population with and without water meters (percent)



Data source: Municipal Water Use Database, Environment Canada.
Adapted by: National Indicators and Reporting Office, Environment Canada.

Metering encourages conservation
Unmetered households, which pay a flat rate for water, use 50% more water than metered households, which pay for water by volume used (based on 1999 data).

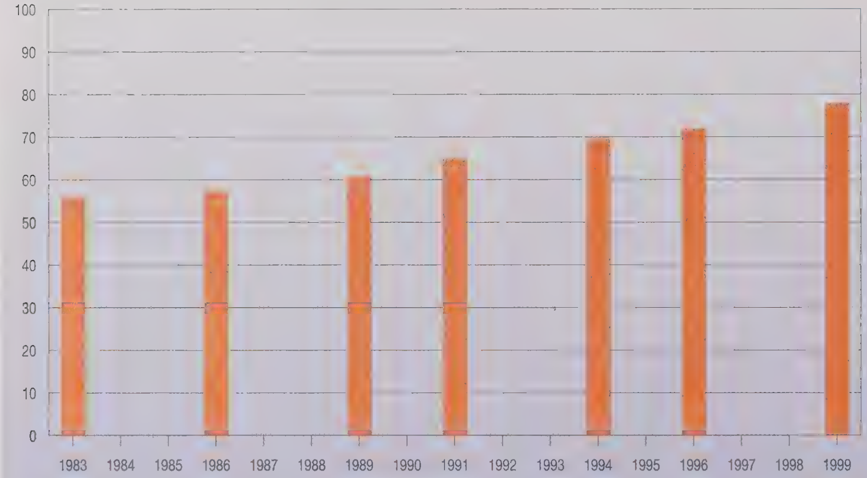
according to the volume used. Further research is needed into the potential impacts of climate change on the quantity and quality of Canada's supplies of fresh water. Related to the indicators themselves, the survey that generates the data is being revamped, which may make it difficult to compare indicator results with those from previous years. On the other hand, more rigorous definitions will improve the accuracy and completeness of the information presented.

Notes

Municipal wastewater treatment

Municipal wastewater treatment improving in Canada: up 20% since 1991

Municipal population on sewers with secondary and/or tertiary treatment (percent)



Data source: Municipal Water Use Database, Environment Canada.

Adapted by: National Indicators and Reporting Office, Environment Canada.

Meter Calculation

Percent difference between the percentage of population on sewers with secondary and/or tertiary treatment in 1991 and 1999

Treatment levels

Primary: Removal of debris and suspended solids by screening and settling.

Secondary: Use of biological processes to break down organic material and remove additional suspended solids.

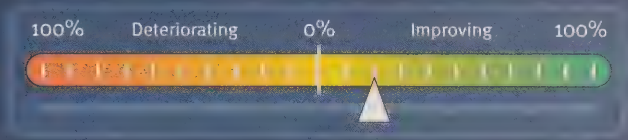
Tertiary: Use of additional filtering or chemical or biological processes to remove specific compounds or materials that remain after secondary treatment.

Context

Municipal wastewater effluents represent one of the largest threats to the quality of Canadian waters. They are made up of both sanitary sewage and stormwater and can contain grit, debris, suspended solids, disease-causing pathogens, decaying organic wastes, nutrients, and about 200 identified chemicals. Municipal wastewater can result in increased nutrient levels, often leading to algal blooms; depleted dissolved oxygen, sometimes resulting in fish kills; destruction of aquatic habitats with sedimentation, debris, and increased water flow; and acute and chronic toxicity to aquatic life from chemical contaminants, as well as bioaccumulation and biomagnification of chemicals in the food chain. The release of untreated or inadequately treated municipal wastewater effluents may put Canadians at risk from drinking water contaminated with bacteria, protozoans (such as *Giardia* and *Cryptosporidium*), and several toxic substances. Canadians are also put at risk from consuming contaminated fish and shellfish and engaging in recreational activities in contaminated waters. Treatment plants remove varying amounts of contaminants from wastewater, depending on the level of treatment they provide.

Indicators

In 1999, 78% of the municipal population on sewers was receiving secondary and/or tertiary water treatment, up from 56% in 1983. These additional levels of treatment use biological and/or chemical processes to further remove organic material, suspended solids, and other substances from the water. The effects of these improvements in



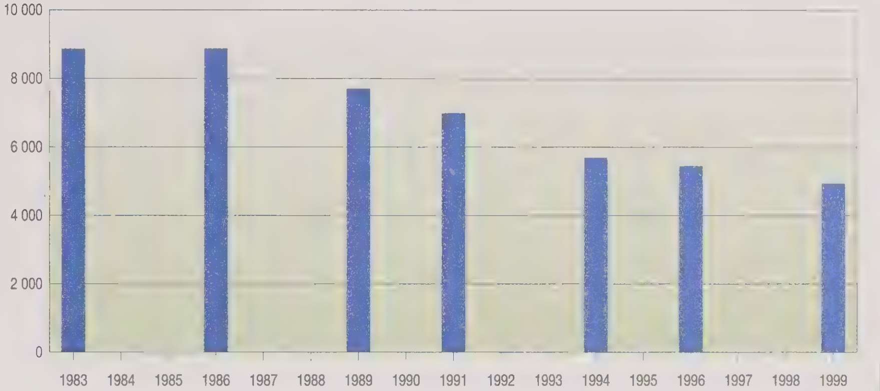
sewage treatment are illustrated by the decline in phosphorus loadings that has taken place over the same period. For Canada as a whole, estimated yearly loadings of phosphorus fell by 44% between 1983 and 1999, despite the 24% increase in urban population. In 1999, 19% of the municipal population on sewers were receiving primary treatment, and 3% discharged untreated sewage directly into their receiving water bodies. The level of wastewater treatment in Canada differs greatly between municipalities discharging to coastal versus inland (fresh) waters. In 1999, about 84% of the inland municipal population served by sewers received secondary or tertiary wastewater treatment, and 15% received only primary treatment. By contrast, only a minority of coastal municipalities served by sewers had secondary treatment, while most had primary or no treatment at all.

Actions

Federal, provincial, and territorial jurisdictions are exploring strategies

Phosphorus loadings in municipal wastewater effluents declining

Total estimated phosphorus loadings to Canadian waters from municipal wastewater treatment plants (tonnes per year)



Data sources: Municipal Water Use Database, Environment Canada; Chambers et al., 2001.

Adapted by: National Indicators and Reporting Office, Environment Canada.

Higher levels of treatment more available to inland waters than coastal waters

Level of treatment of municipal wastewaters in Canadian coastal and inland receiving waters, 1999 (based on municipalities serviced by municipal sewer systems) (percent)

Data source: Municipal Water Use Database, Environment Canada.

Adapted by: National Indicators and Reporting Office, Environment Canada.

to ensure consistent and improved management of municipal wastewater in Canada. Additionally, measures such as municipal source control programs minimize the entry of pollutants such as metals into sewer systems, thus reducing treatment costs and improving municipal wastewater effluent quality. As described in the section on municipal water use, the federally funded Green Municipal Investment Fund, the Green Municipal Enabling Fund, and the Infrastructure Canada Program are important initiatives designed to improve water and wastewater infrastructure in Canadian municipalities.

Linkages

Excessive water use reduces wastewater treatment efficiency. Reduced municipal water use reduces the need for increasing the capacity of water treatment infrastructure and lowers the energy needed to build and operate the infrastructure. Advances in municipal wastewater treatment reduce the level of nutrients and toxic substances in downstream water, improving water quality for aquatic ecosystems and human use. Artificial wetlands and other innovative “biosystem approaches” to wastewater treatment can have benefits for wildlife and contribute to greenhouse gas reduction.

Challenges

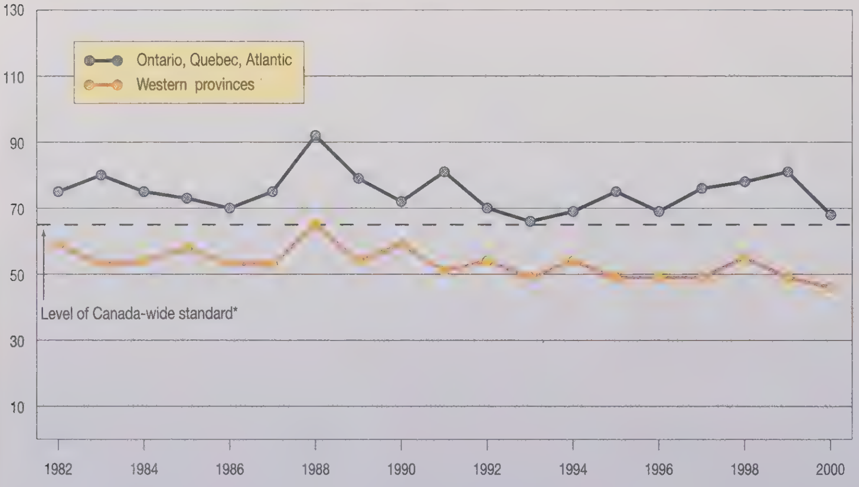
Canada is comparable with other developed countries in the percentage of the population receiving wastewater treatment. However, there are still communities without wastewater treatment, and existing infrastructure is faltering in many parts of the country. Even in areas with a high degree of wastewater treatment, some chemicals, many with unknown ecological consequences, may be released to the environment. As an example, endocrine disrupting substances as well as pharmaceuticals can pass through even the most advanced wastewater treatment systems. Endocrine disrupting substances are known to disrupt or mimic naturally occurring hormones and may have an impact on the growth, reproduction, or development of many species of wildlife.

Notes

Urban air quality

Levels of ground-level ozone variable

Average concentrations of ground-level ozone in Canada (parts per billion)



Data source: National Air Pollution Surveillance Network.

Adapted by: National Indicators and Reporting Office, Environment Canada.

Meter Calculation

Trend from 1990 to 2000 for each region

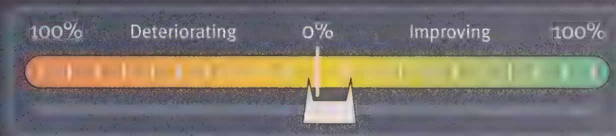
Ground-level ozone

Ground-level ozone is a naturally occurring gas in the lower atmosphere that increases in concentration when volatile organic compounds and nitrogen oxides react in the presence of sunlight, heat, and stagnant air. It is harmful to human health and the environment.

* The *numerical* level of the ozone Canada-wide standard (CWS) is included for qualitative purposes only. Achievement of the CWS numerical value is not required until 2010, and it can be assessed only if the conditions specified in the *Guidance Document on Achievement Determination* have been satisfied, which is strictly not the case for the data in the above chart.

Context

High levels of pollution adversely affect most of the populated regions of Canada. Levels of airborne particles vary depending on the region, the level of pollutant emissions from both local and long-range transport sources, and the season. Although there have been improvements in levels of primary airborne pollutants, many parts of Canada, both urban and rural, continue to experience unacceptable air quality, especially in the summer. In many locations, ground-level ozone and airborne particles combine with other air pollutants to produce smog. Emissions of nitrogen oxides, sulphur dioxide, ammonia, and volatile organic compounds contribute to these concentrations of ground-level ozone and airborne particles. Fine particles, those with diameters less than or equal to 2.5 micrometres ($PM_{2.5}$), pose the greatest threat to human health, because they can travel deepest into the lungs. Air also contains trace amounts of many toxic chemicals. Most air pollutants come from the combustion of fossil fuels in motor vehicles, factories, industrial or thermal power plants, and home furnaces. Some air pollutants injure plants, reducing crop yields and forest growth. In humans, air pollution can irritate the eyes, nose, and throat, reduce lung capacity, and aggravate respiratory diseases.



Indicators

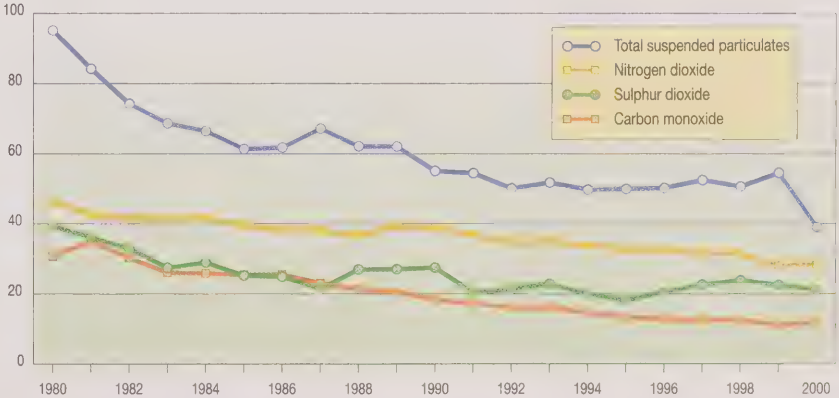
Ground-level ozone levels have not changed significantly across Canada, although they tend to be higher east of the Manitoba/Ontario border. Levels are heavily dependent on the weather, with the highest levels occurring in the warmer months. Ground-level ozone is a concern principally in the Windsor–Quebec City corridor and, to a lesser extent, in the southern Atlantic region and the Lower Fraser Valley of British Columbia. Ambient levels of several other important pollutants have dropped over the last 10 years in urban areas. Meanwhile, emissions of volatile organic compounds from all sources have not shown an improvement. Changes in monitoring methods for fine particulates ($PM_{2.5}$) make it difficult to determine historical trends, but the data available do show that many areas record daily levels that can lead to adverse health effects.

Actions

In 2000, Canada signed the Ozone Annex under the 1991 Canada–U.S. Air Quality Agreement to reduce the flow of air pollutants across the Canada–U.S. border. Consequently, the Government of Canada announced a commitment of $120 million over 4 years as part of a 10-year program to invest in new measures to accelerate action on clean air by focusing on cleaner vehicles and fuels, initial measures to reduce smog-causing emissions from industrial sectors, improvements to the cross-country network of air pollution monitoring stations, and expansion of the public reporting on pollutant releases by industry. Also in 2000, the Canadian Council of Ministers of the Environment endorsed Canada-wide standards for ground-level ozone and fine particulate matter ($PM_{2.5}$). These standards set targets for ambient concentrations that have to be achieved by the year 2010. Slightly coarser particulate matter, particles with diameters less than or equal to 10 micrometres (PM_{10}), has been added to the Toxic

Levels of several air pollutants dropping in Canada

Levels of total suspended particulates, nitrogen dioxide, sulphur dioxide, and carbon monoxide in Canada, as percentage of maximum acceptable levels



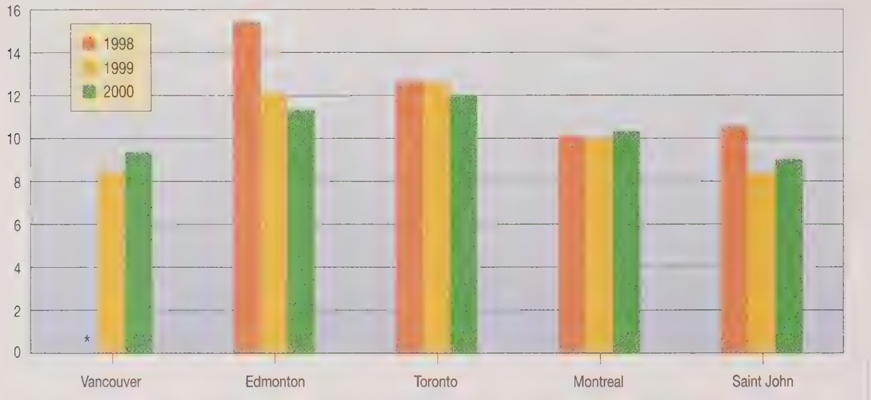
Data source: National Air Pollution Surveillance Network.
Adapted by: National Indicators and Reporting Office, Environment Canada.

Smog

Smog has become a common term for urban air pollution. It contains two key elements: fine airborne particles and ground-level ozone.

Levels of fine particulate matter still a concern

Average annual ambient concentrations of fine particulate matter ($PM_{2.5}$) (micrograms per cubic metre)



Data source: National Air Pollution Surveillance Network.

Adapted by: National Indicators and Reporting Office, Environment Canada.

Note: Natural sources also contribute to elevated particulate matter levels.

* No data available.

Fine particulate matter ($PM_{2.5}$)

$PM_{2.5}$ consists of solid or liquid particles with diameters less than or equal to 2.5 micrometres (1 micrometre = 1 millionth of a metre) in size. They can penetrate deep into the lungs and pose the highest risk to human health.

Data for national trends in $PM_{2.5}$ have only recently started to become available due to an improvement in monitoring techniques.

Substances List under the *Canadian Environmental Protection Act, 1999*. New regulations require reductions in sulphur in gasoline across Canada to 150 parts per million by 2002 and 30 parts per million by 2005.

Linkages

Reductions in emissions from fossil fuel combustion will improve air quality by directly reducing emissions of sulphur dioxide, nitrogen oxides, and volatile organic compounds and indirectly reducing levels of ground-level ozone and inhalable airborne particles formed in the atmosphere. Such reductions will also reduce emissions of carbon dioxide, a greenhouse gas with a key role in climate change. Reductions in emissions of sulphur dioxide and nitrogen oxides can also be expected to reduce acid rain. Because passenger vehicles are a leading consumer of fossil fuels, vehicle emission controls under various sustainable transportation initiatives will help to improve air quality.

Emissions of volatile organic compounds remain constant

Emissions of non-methane volatile organic compounds across Canada from all sources, 1980–2000 (thousands of tonnes)

Data source: Criteria Air Contaminants Database, Environment Canada.
Adapted by: National Indicators and Reporting Office, Environment Canada.

Challenges

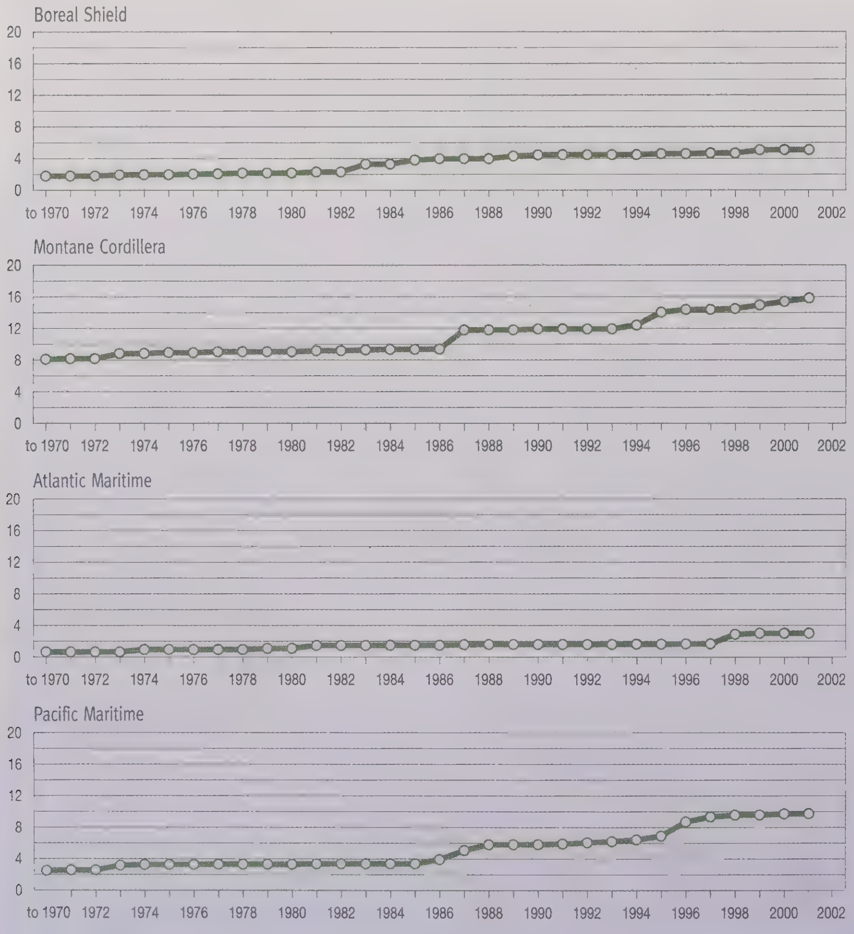
Air quality varies locally as a result of local emissions, topography, weather, and long-range transport. Considering the substantial variation in air quality concerns across the country, national averages may not be the preferred mechanism for tracking the issue. Furthermore, air quality indicators considered individually do not provide the full story of the effects of poor air quality. Better information is always needed, including more comprehensive and up-to-date information on emissions and a better understanding of the chemistry of pollutants in the atmosphere and their combined toxicity to humans and ecosystems.

Natural Resources Sustainability

Forestry

Percentage of ecozone with strictly protected forest area has increased: up 32% since 1992

Strictly protected forest area in selected forested ecozones (percent)

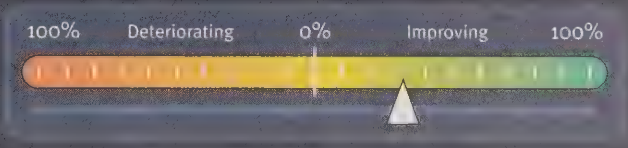


Data source: Canadian Council on Ecological Areas Database; Canadian Wildlife Service, Environment Canada.
Adapted by: National Indicators and Reporting Office, Environment Canada.

Meter Calculation

Trend in strictly protected area for all four ecozones from 1992 to 2001

Strictly protected areas
Strictly protected areas are equivalent to the World Conservation Union (IUCN) classes I–III and exclude human activities such as forestry, mining, and agriculture.



Context

Canada is home to 10% of the world's forests, including one-quarter of the Earth's boreal forests. Forests cover approximately 45% of Canada's total land area. Several forest types constitute this extensive forest cover. Canada's forests play many vital ecological roles. They produce oxygen and remove carbon dioxide from the atmosphere, they purify water, and they help to moderate climate, stabilize soil, and regulate water flow. Forests also provide diverse habitats for two-thirds of Canada's wildlife — and new species are continually being discovered. Forests also act as wind breaks, as snow traps, and in sediment control. They are vital to the economy, producing wood and wood products used domestically and for export, while providing jobs for thousands of Canadians. Approximately 59% of Canada's forested land is considered capable of producing timber products.

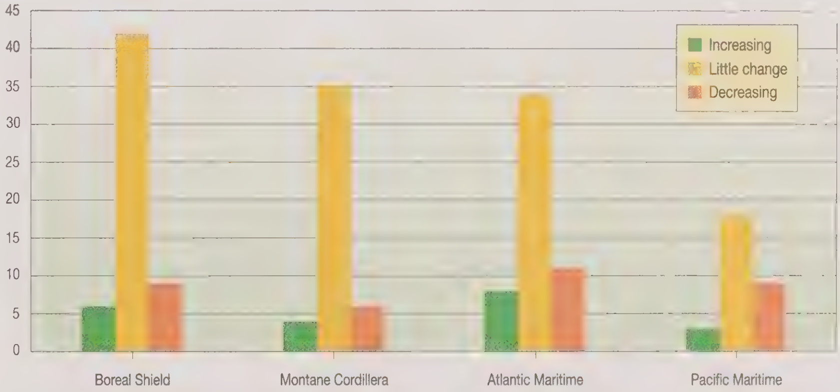
Forest management practices can profoundly affect forests, in terms of both their economic productivity and their biodiversity. Logging poses a threat to those species of flora and fauna that depend on old-growth forests for large, unbroken tracts of forest. Forests are managed for multiple benefits, such as improving timber yields; controlling fires, diseases, and insects through practices such as reseeding, tree planting, and fire suppression; and conserving forest biodiversity. Some practices can affect forest condition through soil compaction and erosion; can cause habitat destruction, fragmentation, and edge effect, which place some forest-dependent species at risk; and can alter natural cycles of insects, disease, and fire.

Indicators

Much of Canada's forest industry is located in four ecozones — the Boreal Shield, Atlantic Maritime, Pacific Maritime, and Montane Cordillera. The collective amount of strictly protected area in these ecozones increased from 5.3% in 1992 to 6.8% in 2001 and accounts for about 18% of the total strictly protected area in Canada.

Populations of most forest bird species showing little change

Population status of forest bird species in selected forested ecozones, 1968–2000 (number of species)



Data source: National Wildlife Research Centre, Canadian Wildlife Service.

Adapted by: National Indicators and Reporting Office, Environment Canada.

Increasing: Species increasing at a rate of 50% or more per 20 years.

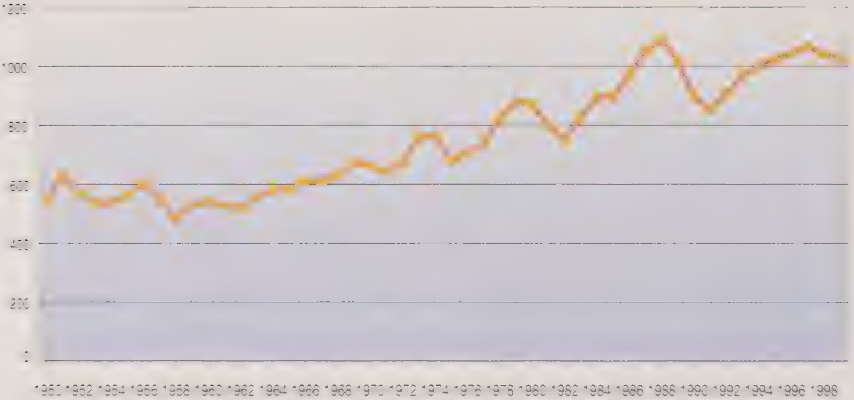
Little change: Species changing at a rate less than 50% per 20 years.

Decreasing: Species decreasing at a rate of 50% or more per 20 years.

The rate of change is calculated using a period of 20 years beause this is a magnitude of change that is considered to be larger than would be expected in a stable population.

Annual timber harvest continues to rise

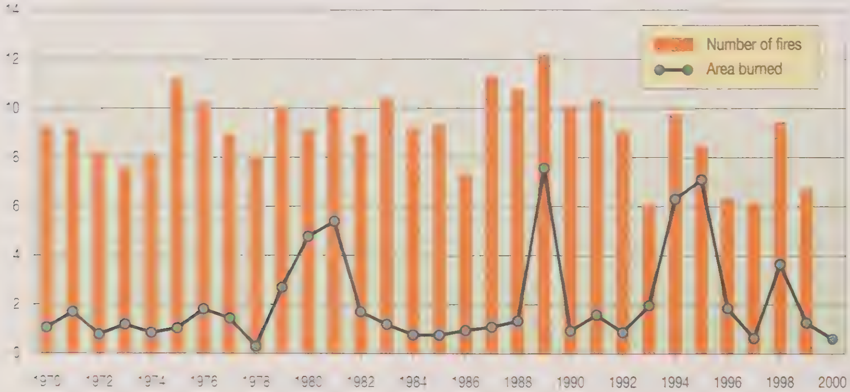
Total area harvested (thousands of hectares)



Data source: National Forestry Database Program, Canadian Forest Service, Natural Resources Canada.
Adapted by: National Indicators and Reporting Office, Environment Canada.

No obvious increase in forest fires

Number of forest fires in Canada (thousands) and area burned (millions of hectares)



Data source: National Forestry Database Program, Canadian Forest Service, Natural Resources Canada.
Adapted by: National Indicators and Reporting Office, Environment Canada.

In these ecozones, most populations of forest bird species showed little change from 1968 to 2000.

Forest harvest levels have steadily increased over the past decade. Since 1994, more than a million hectares a year have been cut — an area almost twice the size of Prince Edward Island. Since 1990, there has been an average of over 8200 forest fires per year; in 2000, 600 000 hectares of forest were burned. Fire suppression has advantages and disadvantages. While it may protect habitat and timber-productive forests over the short term, some amount of fire is necessary for ecological processes such as nutrient recycling and the removal of forest debris. Suppressing naturally occurring forest fires from year to year increases the chances of a larger, more devastating fire at a later date. Between 1980 and 1996, consecutive years of defoliation by the spruce budworm affected a total of more than 69 million hectares of forest. In 1998 alone, insect defoliation affected 6.3 million hectares.

Regeneration of forests affected by insects and fires is usually left to natural processes. More than half of the commercially harvested land is managed for natural regeneration through some form of preparatory site treatment, and the remaining area is planted or seeded. In 1999, 372 000 hectares were planted and 24 000 hectares were seeded.

Actions

In 1992, at the United Nations Conference on Environment and Development in Brazil, Canada signed on to the "Forest Principles" (Non-Legally Binding Authoritative Statement of Principles for a Global Consensus on the Management, Conservation and Sustainable Development of All Types of Forests) and other commitments related to the sustainable management of forests. Also in 1992, Canada signed the United Nations Convention on Biological Diversity. The National Forest Strategy was chosen to be the main vehicle to implement these commitments. Canada took the lead in bringing together international experts on the sustainable development of boreal and temperate forests, leading to the 1994 formation of the Working Group on Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests, now known as the Montreal Process. The first criteria and indicators report for Canada was issued in 2000 by the Canadian Council of Forest Ministers, reporting on 62 forest indicators, including 3 on ecosystem diversity and 3 on species diversity. Another agreement, the Convention on the Protection of Migratory Birds in the United States and Canada, offers protection to one segment of the forest bird population.

Consecutive years of spruce budworm defoliation, 1980–1996

Data source: Natural Resources Canada.

Linkages

Forests are linked to the issues of air quality and climate change because of their role in gas exchange and carbon cycling. Climate change is expected to alter forest composition and productivity, tree growth, wildlife habitat and range, the incidence of forest fires, conditions for competing invasive species, and cycles of disease and insect disturbance in forests. Several pollutants affect forest ecosystems. Ground-level ozone may adversely affect the metabolic systems of plants and is toxic to trees. Acid deposition disrupts biogeochemical processes and may reduce the annual accumulation of forest biomass. Nitrates and heavy metals can affect forest productivity and biodiversity, as well as polluting groundwater. Roadways fragment forest land, changing the tree species mix and interfering with animal activities such as migration. Roads also make human activities such as camping, hunting, and all-terrain vehicle use more accessible, which adds further pressure to the ecosystem.

Maintaining forest biodiversity protects the economic potential of future opportunities for new non-timber products, such as foods and medicines. It also reduces the risk of insect and disease disturbances associated with limited-species stands, thus protecting the timber harvest. Maintaining large forest areas contributes to the fixation of carbon dioxide in biomass and reduces the level of this greenhouse gas in the atmosphere. Diverse forests support social sustainability by offering aesthetic, spiritual, and recreational settings for people.

Challenges

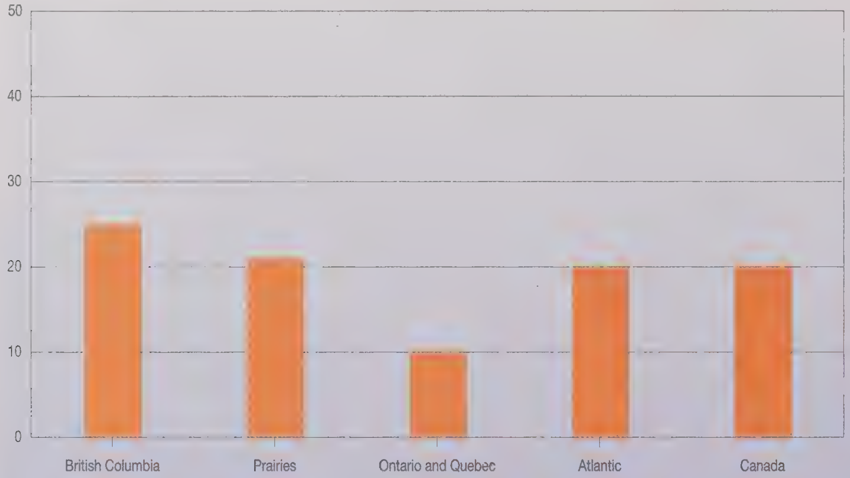
Protecting representative forests continues to be an important goal for Canada. Developing methodologies to quantify the value of ecosystem services provided by forests is becoming increasingly important, to ensure that all forest values are equally weighted when forest development decisions are made.

Notes

Agricultural soils

Canadian agricultural soils are better protected: the number of days soil left uncovered by vegetation decreased 20% between 1981 and 1996

Reduction in number of bare-soil days on agricultural land between 1981 and 1996
(percent change)



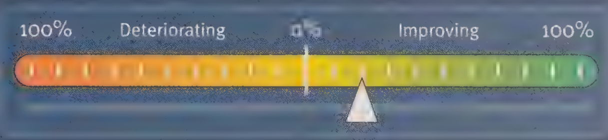
Data source: Environmental Sustainability of Canadian Agriculture: Report of the Agri-Environmental Indicator Project, Agriculture and Agri-Food Canada.
Adapted by: National Indicators and Reporting Office, Environment Canada.

Meter Calculation

Percent change between 1981 and 1996 Canadian values

Context

Healthy soils are the foundation of sustainable agriculture in Canada. They provide a medium for plant growth; hold water, air, nutrients, and soil biota; and receive organic wastes, recycling nutrients back to plants. On a larger scale, they hold and break down contaminants and exchange gases with the atmosphere, influencing global climate. Over the years, agricultural practices have contributed to soil degradation and impacted the environment. Erosion of agricultural land by both water and wind and the accompanying loss of nutrients compromise the productivity and health of the soil. Activities such as tillage, cropping patterns, fertilization, and pest control have accelerated the natural degradation processes of erosion, loss of organic material and fertility, compaction, and salinization. Agricultural practices cause the emission of many contaminants into the air, including several greenhouse gases, ozone-depleting substances, particulate matter, and other gases. Nitrogen is an important nutrient required for plant growth, but excessive nitrogen causes environmental stresses by polluting groundwater and surface water and serving as a greenhouse gas. Conservation farming practices can help maintain or enhance soil health, improving both farm profitability and environmental performance.

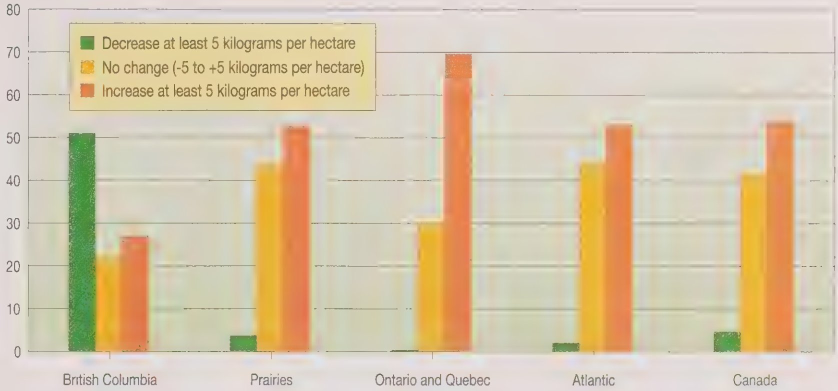


Indicators

Soil cover by crop or crop residue is one way of offsetting the impacts of erosion, and agricultural practices are beginning to reflect this. Between 1981 and 1996, the average number of bare-soil days in Canada's agricultural regions dropped by almost 20%, from 98 to 78. The percentage of agricultural land in Canada experiencing unsustainable water erosion decreased from 1981 to 1996, largely due to decreases achieved in the Prairies. For the same period, the percentage of Prairie agricultural land at risk from unsustainable levels of wind erosion decreased from 59% to 36%, but the percentage at risk from unsustainable levels of salinization has not changed. Residual nitrogen levels in agricultural soils increased markedly between 1981 and 1996 in all provinces except British Columbia. Provincially, the share of farmland showing an increase of at least 5 kilograms of residual nitrogen per hectare during this period ranged from 27% in British Columbia to 80% in Manitoba. What has happened since 1996 will be known when the data from the 2001 agricultural census have been analyzed and the Soil Landscapes of Canada database has been updated.

Residual nitrogen levels increasing everywhere except British Columbia

Changes in residual nitrogen levels between 1981 and 1996 (percent change of agricultural land)



Data source: Environmental Sustainability of Canadian Agriculture: Report of the Agri-Environmental Indicator Project, Agriculture and Agri-Food Canada.
Adapted by: National Indicators and Reporting Office, Environment Canada.

Residual nitrogen

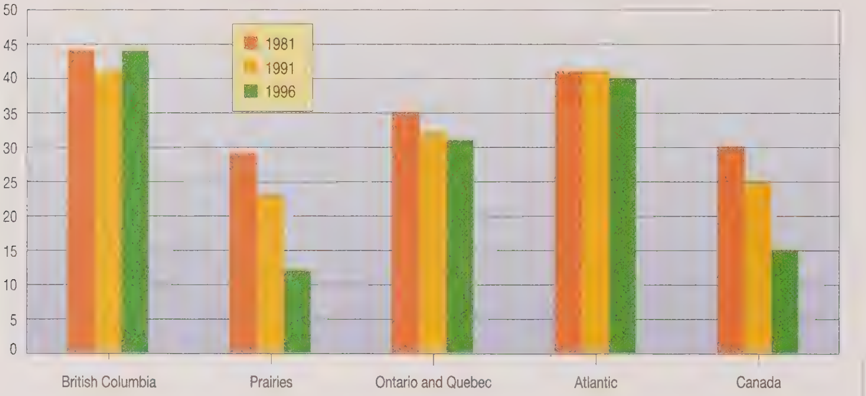
Residual nitrogen refers to the difference between the amount of nitrogen available to the growing crop and the amount removed by the harvested crop. Residual nitrogen often leaches out of soils into ground and surface water where it negatively affects water quality.

Actions

During the 1980s, the Federal–Provincial Soil and Water Accords and the National Soil Conservation Program addressed the issue of land degradation caused by agriculture. In 1989, Agriculture and Agri-Food Canada began to monitor agricultural soil quality through its Soil Quality Evaluation Program. In 1993, the department undertook a program to develop agri-environmental indicators, which were first reported in 2000. These initiatives have provided much of the information needed to identify the agriculture sector's role in meeting Canada's commitments under agreements such as the United Nations Framework Convention on Climate Change, the United Nations Convention on Biological Diversity, and the Montreal Protocol on Substances that Deplete the Ozone Layer.

Risk to Canadian agricultural soils from wind and water erosion dropping

Agricultural land subject to unsustainable water erosion (percent share of agricultural land)

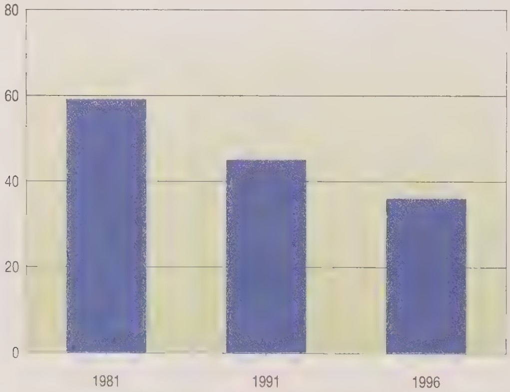


Data source: Environmental Sustainability of Canadian Agriculture: Report of the Agri-Environmental Indicator Project, Agriculture and Agri-Food Canada.
Adapted by: National Indicators and Reporting Office, Environment Canada.

Sustainable erosion

Sustainable erosion is a term used to describe a condition where rates of erosion are compensated for by natural soil-forming processes and agricultural practices that result in the addition of soil organic matter.

Prairie agricultural land subject to unsustainable wind erosion (percent)



Data source: Environmental Sustainability of Canadian Agriculture: Report of the Agri-Environmental Indicator Project, Agriculture and Agri-Food Canada.
Adapted by: National Indicators and Reporting Office, Environment Canada.

Linkages

Healthy agricultural soils have good potential to act as carbon sinks, possibly helping Canada to offset its greenhouse gas emissions. However, some agricultural practices related to soil management, such as manure management and no-tillage, may release nitrous oxide into the atmosphere, contributing to the buildup of greenhouse gases. Water and wind erosion remove organic carbon from the soil, reducing their potential as a carbon sink. Wind erosion of soil is also related to levels of airborne particulates, an element of air quality. Because excess crop nutrients can run off or leach through agricultural soils into waterways, residual nitrogen levels in soils are linked to water quality. The use of

fumigants like methyl bromide contributes to the destruction of stratospheric ozone. Farm vehicles and machinery, transportation and shipping that support the agricultural industry, and the production of agrichemicals such as pesticides are dependent on fossil fuels, linking agriculture to both energy consumption and greenhouse gas emissions. Links to biodiversity issues are important, since agricultural lands can include patches of important habitat for wildlife, and crops and livestock tend to be based on limited genetic pools.

Challenges

Indicator calculations are based on generalized census, landscape, and climate data, possibly masking small land areas where soil degradation is a concern. Better data are needed to make the indicators meaningful for detailed interpretation. The residual nitrogen indicator would benefit from better estimates of nitrogen input into the soil, and the erosion indicators could improve with greater consideration of erosion control practices, severe weather events, and small land areas that are particularly susceptible to soil degradation.

Salinization risk remains unchanged

Prairie agricultural land subject to unsustainable salinization (percent)

Data source: Environmental Sustainability of Canadian Agriculture: Report of the Agri-Environmental Indicator Project, Agriculture and Agri-Food Canada.

Adapted by: National Indicators and Reporting Office, Environment Canada.

Salinization

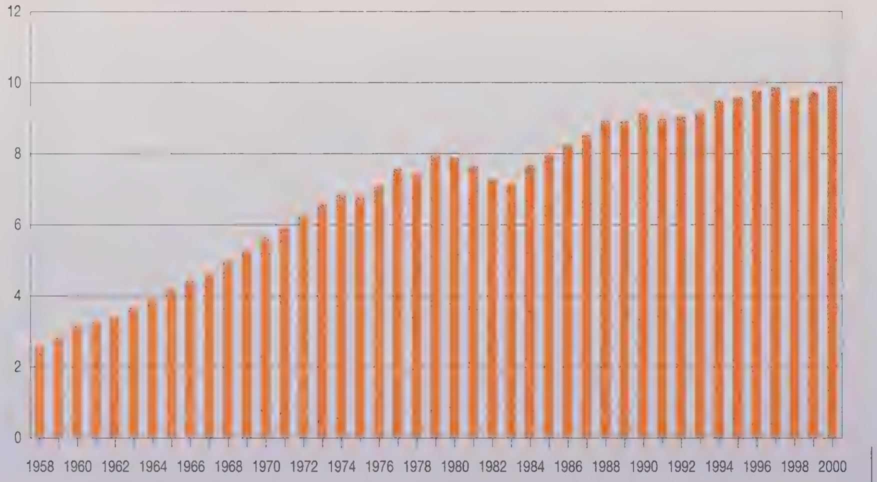
Elevated concentrations of salts make it difficult for plants to absorb water from the soil, as well as being toxic to plants at extreme levels.

Human Activities

Energy consumption

Canadian energy consumption has increased: up 10% since 1990

Canadian energy consumption (exajoules)



Data sources: Energy Division, Statistics Canada; Natural Resources Canada.
Adapted by: National Indicators and Reporting Office, Environment Canada.

METER CALCULATION

Trend from 1990 to 2000

Exajoules

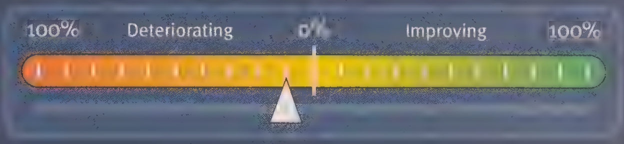
10^{18} joules

Primary energy use

Primary energy represents the total requirements for all uses of energy including secondary energy use

Context

Canada ranks as the world's sixth largest user of primary energy. This high level of use can be attributed to vast travel distances, a cold climate, an energy-intensive industrial base, relatively low energy prices, and a high standard of living. Energy use of this magnitude has a significant impact on the environment. The combustion of fossil fuels, the most widely used forms of energy, releases gases and chemicals that contribute to acid rain, poor air quality, and climate change. Oil spills, blow-outs, and unsustainable mining practices can damage ecosystems. The depletion of known fossil fuel reserves requires continued exploration and mining, with the potential for the invasion and disruption of remote ecosystems. Other forms of energy also pose risks to the environment. Nuclear energy production has few emissions, although waste heat can significantly disturb aquatic ecosystems. Radioactive waste continues to be harmful for thousands of years, so its safe storage remains an environmental concern. Hydroelectric power is a cleaner form of energy; however, dams built to generate electricity alter natural river courses and silting patterns, flood habitat, affect fish spawning, and can change the chemical balance of a lake or river. Energy sources such as solar and wind power are available but make up only a fraction of the energy consumed in Canada.



Indicators

Canada's energy consumption in 2000 was 9.9 exajoules, up 10% from 1990. Canada's per capita energy consumption has decreased since 1990, however, indicating that efforts to increase energy efficiency may be working. Improvements in energy efficiency have had only a minor effect on total energy use, however. Fossil fuel use in Canada increased by 20% since 1990. In 1999, Canada's energy use accounted for 2.5% of total global energy consumption and 2.5% of the total fossil fuels used.

Actions

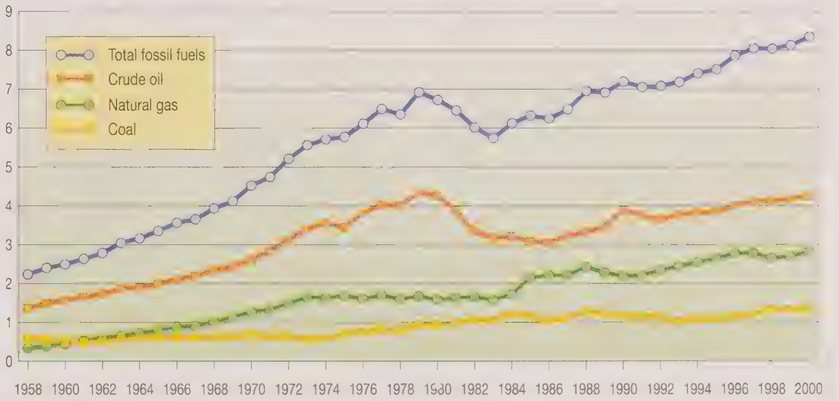
Canada has implemented several programs since 1990 with the ultimate goals of encouraging energy efficiency and creating awareness of alternative and more energy-efficient practices among Canadians. Several programs set requirements for building and equipment standards. Voluntary programs help consumers and businesses become more aware of energy-saving measures for buildings, automobiles, and heating and air conditioning; as well, there are programs targeting federal buildings and fleets. Research and development also continue in order to find more efficient means of burning energy and to develop additional alternative energy sources, such as wind power and biomass. Since greenhouse gas emissions are largely related to energy consumption, programs aimed at reducing greenhouse gas emissions will also reduce energy use. Internationally, Canada is active in efforts to strengthen energy security and reliability, promote clean and efficient technologies, and improve energy efficiency, such as the energy initiatives of the Asia Pacific Economic Cooperation and the 1994 Summit of the Americas.

Linkages

Fossil fuels are the dominant form of energy consumed in Canada. The combustion of fossil fuels emits greenhouse gases, such as carbon dioxide and nitrous oxide, which accumulate in the atmosphere and contribute to climate change. Pollutants such as sulphur dioxide and nitrogen oxides are also by-products of fossil fuel combustion and are primary contributors to acid rain and poor air quality. The transportation sector is one of the largest consumers of energy and is extremely dependent on fossil fuels in particular. Fossil fuel spills, waste heat, and habitat destruction associated with mining and damming pose a risk to wildlife and contribute to changes in biodiversity.

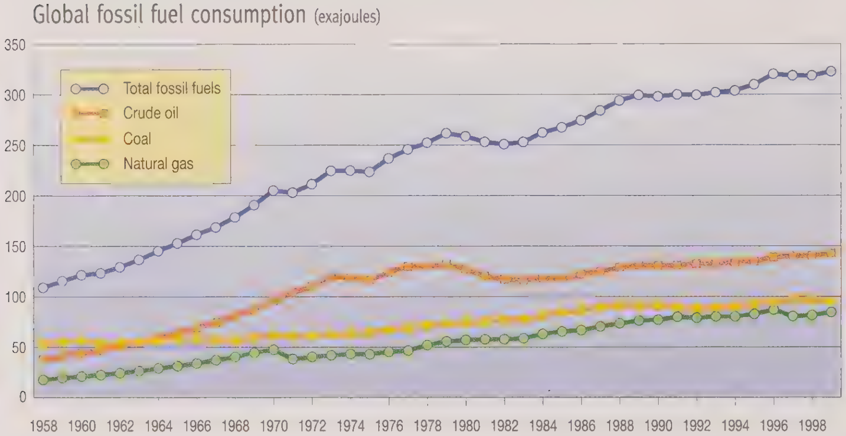
Canadian fossil fuel consumption continues to climb

Canadian fossil fuel consumption (exajoules)



Data source: Energy Division, Statistics Canada; Natural Resources Canada.
Adapted by: National Indicators and Reporting Office, Environment Canada.

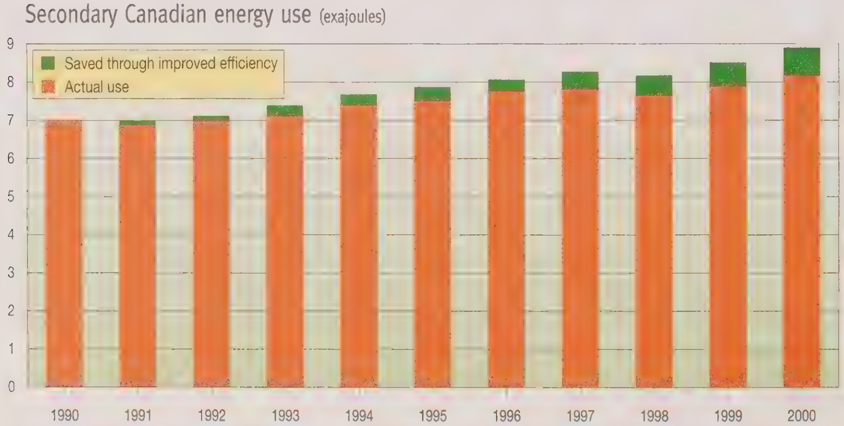
Global fossil fuel consumption continues to climb



Data sources: United Nations; International Energy Agency; Worldwatch Institute.

Adapted by: National Indicators and Reporting Office, Environment Canada.

Energy efficiency improving, but energy use still increasing



Data source: Office of Energy Efficiency, Natural Resources Canada.

Adapted by: National Indicators and Reporting Office, Environment Canada.

Secondary energy use

Secondary energy is energy used by final consumers for residential, agricultural, commercial, industrial, and transportation purposes. It does not include intermediate uses of energy for transporting energy to market or transforming one energy form to another.

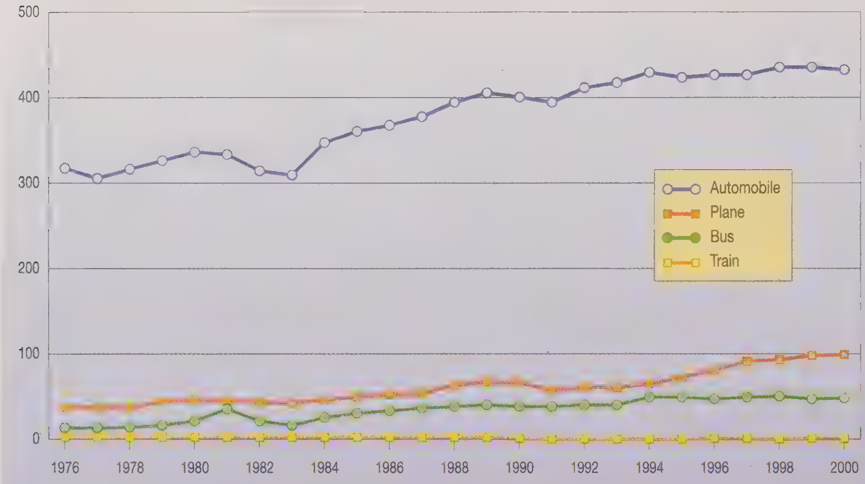
Challenges

Renewable energy currently makes up a small portion of Canada's energy mix, with the exception of large-scale hydroelectric projects. These alternative energies often compete poorly against non-renewable sources for investments. Alternative modes of transportation, such as transit and biking or walking, are important activities to encourage in order to reduce emissions and improve human health. Continued advances in efficiency and alternative fuels may find a solution, but a fundamental shift in thinking is required in order to decrease dependence on fossil fuels and maintain a sustainable level of energy consumption.

Passenger transportation

Automobile use has increased: up 9% since 1990

Passenger travel, by mode (billions of passenger–kilometres)



Data sources: Royal Commission on National Passenger Transportation, Canadian Urban Transit Association; Statistics Canada; Natural Resources Canada.

Adapted by: National Indicators and Reporting Office, Environment Canada.

METER CALCULATION

Trend in automobile use between 1990 and 2000

Definitions

"Automobile" refers to cars and other private-use passenger vehicles, such as vans and small trucks.

"Bus" refers to intercity, transit, and school bus services.

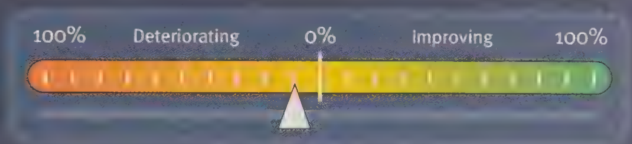
A "passenger–kilometre" is a standard unit for measuring travel. It takes into account both the number of people travelling and the distance travelled.

Context

Transportation is part of the daily lives of most Canadians, providing the access and mobility demanded by our society and economy. Along with these benefits, motorized transportation can stress the environment in a variety of ways. Exhaust emissions contribute to urban air pollution, including smog events, climate change, and acid rain. Spills and leaks of fuel and other materials contaminate soil and water. Demands for fuel deplete fossil fuel resources. Transportation infrastructures (roadways, rights-of-way, maintenance lots) fragment the land, removing it from other uses, such as agriculture, and alter wildlife habitat. Transportation also affects human well-being directly through increased noise and congestion and vehicle-related injuries and death. A prominent aspect of the transportation issue is passenger transportation.

Indicators

Automobile travel has grown by 9% over the last decade. In 2000, for every 100 kilometres travelled by Canadians, 74 kilometres were travelled by automobile. Air travel also grew, experiencing a 50% increase over the last decade. The rise in automobile and air travel reflects the displacement of travel by bus and rail. Total fossil fuel use by automobiles increased by 21% between 1990 and 1999. Fuel efficiency rose dramatically between 1973 and 1982, but has not improved since. Meanwhile, there has been an increased use of less fuel efficient light-duty trucks (including sport utility vehicles). The percentage of automobile passenger–kilometres travelled in light-duty trucks has almost tripled in the last 25 years, from 10% in 1976 to 27% in 2000. Urban transit passenger–kilometres increased by 6% over the last decade, but



have remained a steady 8% of the total urban passenger–kilometres travelled.

Actions

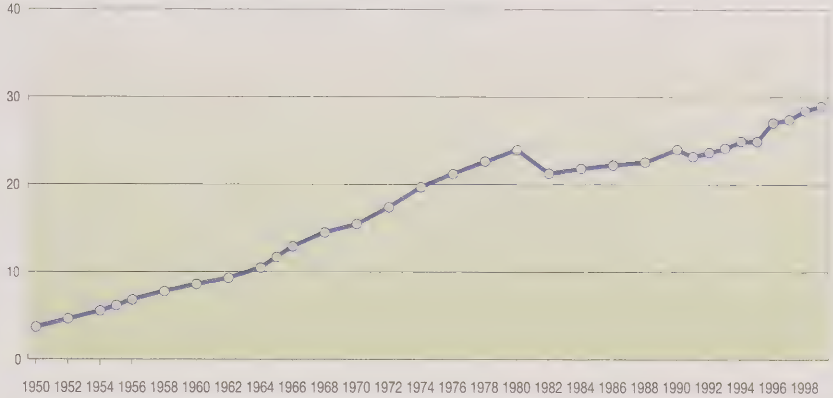
In winter 2001, Canada's environment minister outlined a series of measures over the next decade to reduce transportation emissions, including the development of new regulations. Canada is using intelligent transportation systems to apply advanced technology to improve the functioning of transportation systems, such as traffic flow, mobility in congested corridors, and transfers between different modes of transport, such as automobiles and rail. In spring 2000, Canada's transportation minister announced funding to revitalize Canada's rail service. The federal Auto$mart Program provides Canadian motorists with helpful tips on buying, driving, and maintaining their vehicles to reduce fuel consumption.

Linkages

Transportation is mostly dependent on fossil fuel use, which is linked to air quality, acid rain, and climate change.

Fossil fuel use for passenger transportation continues to rise

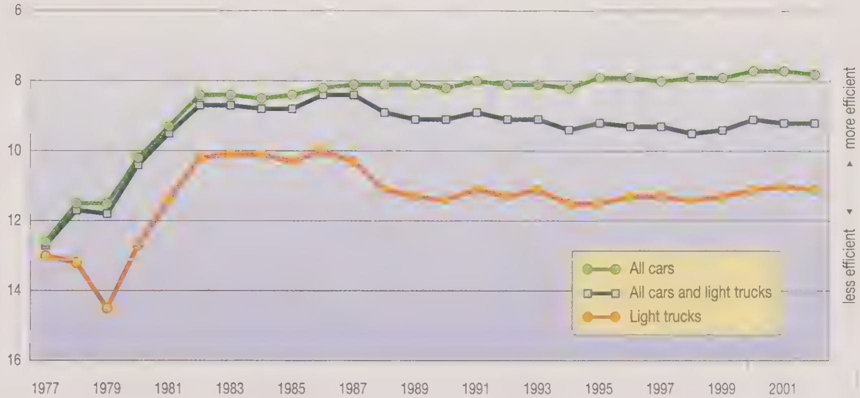
Fossil fuel use by automobiles, vans, and light trucks (billions of litres of gasoline)



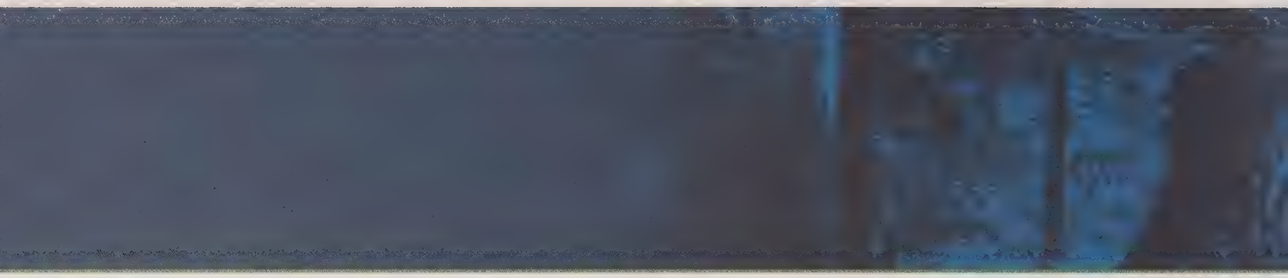
Data source: Natural Resources Canada; Statistics Canada.
Adapted by: National Indicators and Reporting Office, Environment Canada.

Fuel efficiency of new vehicles unchanged since 1982

Fuel efficiency of new vehicles (litres per 100 kilometres)

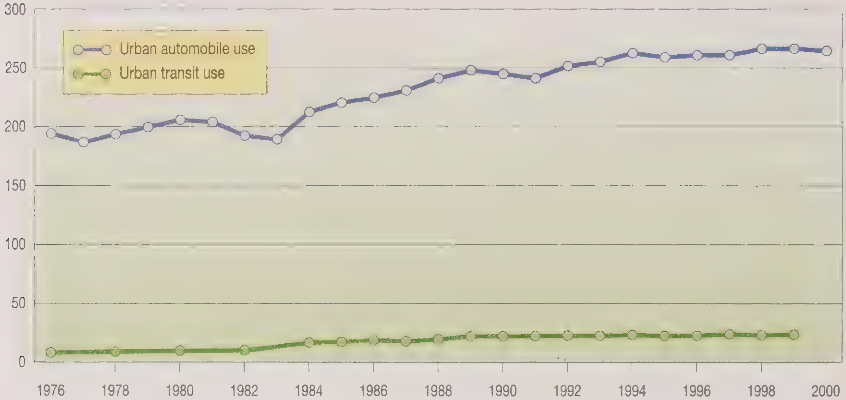


Data source: Natural Resources Canada; Statistics Canada; Transport Canada.
Adapted by: National Indicators and Reporting Office, Environment Canada.



Public transit use remains low while urban automobile use climbs rapidly

Urban automobile and transit use (billions of passenger–kilometres)



Data sources: Royal Commission on National Passenger Transportation; Canadian Urban Transit Association; Statistics Canada; Natural Resources Canada.

Adapted by: National Indicators and Reporting Office, Environment Canada.

Because passenger transportation makes up a large part of total transportation, any changes to reduce its volume and make it more energy efficient will have a direct effect on issues related to air quality and the atmosphere as well as human health. Reducing dependency on automobile use would reduce the need for more expensive, environmentally invasive infrastructure. As global inventories of fossil fuels deplete, the cost of transportation will increase, creating a significant economic impact.

Challenges

Passenger transportation is a growing issue, as urban centres grow and Canadians have farther to travel to work. Efforts made to encourage commuters to shift to public transit have not worked in a significant way. Despite government initiatives in place to increase and encourage energy efficiency, energy efficiency in the passenger transportation sector decreased 1.1% between 1990 and 2002, mainly due to Canadians' growing preference for minivans and sport utility vehicles. More investment will be needed to make public transportation more accessible, efficient, and affordable, in order to shift Canadians' preference away from private passenger transportation. Incentives to adopt green transportation, such as carpooling and bicycling, could assist this shift. Also needed is further work to improve vehicle and fuel efficiencies, develop alternative fuels and vehicles, and implement intelligent transportation systems.

Notes

Municipal solid waste

Per capita non-hazardous solid waste generation has increased: up 10% since 1998

Per capita non-hazardous solid waste disposal and recycling/reuse (kilograms per person)

Data source: Waste Management Industry Survey: Business and Government Sectors 1994, 1996, 1998, 2000, Statistics Canada.

Adapted by: National Indicators and Reporting Office, Environment Canada.

* Recycling data not available for 1994 and 1996.

Meter Calculation

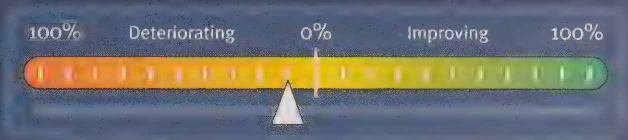
Percent change in total generation between 1998 and 2000

Context

The production of large amounts of solid waste is a major issue, particularly in a consumer society such as Canada. Canadians are often cited as being among the leading per capita producers of solid waste in the world. Inefficient production processes, low durability of goods, and unsustainable consumption patterns lead to excessive waste generation that follows or exceeds trends in economic growth. Non-hazardous solid waste can be diverted through recycling or composting or disposed of in landfills or incinerators. Disposal and incineration have potential environmental effects of soil and water contamination, degraded air quality, loss of valuable land, and deteriorated landscapes. However, waste and its management can represent lost material and energy resources, greenhouse gas and toxics emissions, and a cost of billions of dollars a year. Solid waste management typically focuses on collection, treatment, and disposal, but the minimization of waste is increasingly the aim of sustainability strategies. Minimization can be achieved through waste prevention (intervention before waste is created) and waste diversion (reuse, composting, recycling, and recovery). Increased waste generation corresponds to an increase in the demand for raw materials and non-renewable resources.

Indicators

Despite achievements in waste diversion, waste disposal has remained high. Between 1998 and 2000, per capita non-hazardous solid waste generation increased by 10%.



Forty percent of this solid waste is generated by the industrial, commercial and institutional sector, and one-third by the residential sector. Waste diversion also increased by 10%. Seventy-five percent of the materials diverted included paper, glass, and metals, while plastics comprised 1% by weight. The total waste diversion rate (total waste diverted divided by total waste generated) remained constant at 24% from 1998 to 2000. It is important to note that these figures are based on weight, and a significant issue in waste disposal is the volume of waste. A shift to the use of plastic containers results in the appearance of less waste by weight when there might be an increase in volume.

Actions

Solid non-hazardous waste is managed by the provinces, so initiatives across the country vary. Within each province, individual municipalities are responsible for waste management programs. Many Canadian municipalities have developed and initiated successful recycling programs that are intended to reduce the amount of waste that goes to landfills. Improvements to solid waste management systems are eligible for funding by the Government of Canada through the Green Municipal Funds program. In 1990, the National Task Force on Packaging was formed, with the objective of reducing the amount of packaging waste disposed of. By the end of 1996, a 51% reduction in the weight of packaging waste sent for disposal was achieved. Canada-wide standards have been developed for mercury and dioxin and furan emissions from the incineration of waste.

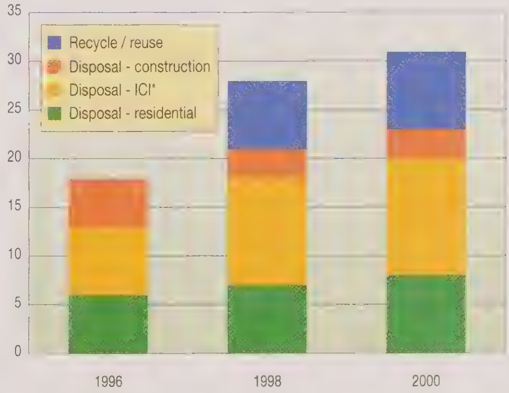
Linkages

Waste disposal sites can impact adjacent water and air quality. Decomposition of the large amounts of organic material in landfills produces methane (a greenhouse gas), which if not recovered for heating or electricity production, contributes to global warming. Although there are some minor greenhouse gas impacts associated with recycling (such as increased transportation), the resulting decrease associated with reduced energy consumption to produce goods from virgin raw materials far outweighs these minor impacts, resulting in a net reduction in greenhouse gas emissions.

Challenges

The primary challenge in Canada is to reduce the amount of solid waste generated. The secondary challenge is to increase the amount of waste diverted from landfill. Waste management activities are varied and involve many different actors. This makes it difficult to aggregate information when trying to describe a realistic picture of activities and total materials managed. Consideration of the environmental impacts associated with waste management activities from a life cycle perspective and the integration of waste management systems are needed. Issues that still need addressing include the volume of waste and its ability to biodegrade.

Total non-hazardous solid waste disposal and recycling/reuse (million tonnes)



Data source: Waste Management Industry Survey: Business and Government Sectors 1994, 1996, 1998, 2000, Statistics Canada.

Adapted by: National Indicators and Reporting Office, Environment Canada.

* ICI – industrial, commercial, institutional

Conclusions

What you can do to live sustainably

The lifestyle choices of Canadians are personal decisions, influenced by individual values and circumstances. Not every Canadian lives in the same way, and it would be impossible to define an ideal sustainable lifestyle appropriate for everyone. Yet if changes do not come, environmental degradation will continue and possibly accelerate.

How much responsibility for making those changes do we, as individuals, have to take on? We all make countless decisions every day about what we buy, how we dispose of waste, whether we walk or take the car, and so on. Yet our choices are limited by the way production is organized in our economy and the values and assumptions built into our society. Individuals and society as a whole are two different entities that continuously influence each other and that are constantly evolving as they track each other's shifts: for example, while consumers complain that manufacturers are not providing adequate choices for a "greener" car, automobile manufacturers claim that they are only responding to consumers' demands. One is very difficult to change without change in the other. It is important, then, that lifestyle change be considered in the context of change in the social system, including the production and supply of goods and services.

There is no easy way to change a society in which habits and behaviours are strongly ingrained. To make change happen, a conscious effort will have to come from all quarters. Institutions must choose to incorporate environmental sustainability as an objective in decision-making, and individuals must try to influence society as consumers, workers, taxpayers, and voters. While seriously considering what defines "quality of life" for them, individuals need to consider ways to encourage sustainable patterns of production and consumption. At the personal level, this can consist of three areas, two of which are a form of "substituting".

First, individuals can substitute behaviours that result in less energy and material use, waste production, and ecosystem degradation. For example:

- Using a bucket, sponge, and trigger nozzle on the hose to wash the car will save about 300 litres of water each time.
- Commuting to work by transit or bicycle, rather than by automobile, will help reduce emissions of greenhouse gases and other air pollutants.
- Proper disposal of pesticides, paints, and solvents will greatly reduce the amounts of toxic contaminants reaching waterways through storm and sanitary sewers.
- Buying multi-use items rather than single-use, using your own cloth bags for shopping, avoiding products with excess packaging, and donating old clothes and books to charity will all help reduce solid wastes.

Second, individuals can substitute more efficient technology or use products that have less environmental impact throughout their life cycle to achieve the same end. Examples include:

- using smaller, more fuel-efficient automobiles and major appliances with the lowest energy consumption ratings, which will reduce emissions of greenhouse gases and air pollutants;
- installing water-saving devices in the home, such as low-flow showerheads and toilet dams;
- using advanced combustion wood stoves, rather than conventional ones, to reduce emissions of air pollutants;
- replacing incandescent light bulbs with compact fluorescent bulbs, which use about 75% less energy and last 10 times longer;
- purchasing non-hazardous or less hazardous paints, solvents, and cleaners, which will reduce the release of toxic contaminants from household and commercial sources.

Finally, in terms of our relationship to society and its institutions, individuals can ask for appropriate information and insist that products, services, and planning at all levels be based on an understanding of environmental implications as well as other factors. For example:

- Individuals can help shed some light on environmental issues by encouraging government to support impartial information gathering and to provide Canadians with clear and consistent messages about the types of products and behaviours that are environmentally sound.
- Individuals can work within their community to encourage better planning of urban transit, cycling routes, and reduced dependency on passenger vehicles.
- Individuals, as consumers, can also encourage producers to demonstrate in a clear, understandable way how they are incorporating environmental considerations into their production processes through such things as environmental impact analysis and product life cycle management.

It may not be possible to eliminate all environmental impact. However, sustainable development requires that we be aware of the environmental effects of our activities and both plan and take action now to reduce those effects. Sustainability requires a balancing act between meeting our needs and wants and maintaining healthy ecosystem functions. There are ways for individuals to meet their needs and aspirations that are less demanding of the Earth's life support systems. There are also opportunities for individuals to re-examine those needs and aspirations. Ultimately, however, society as a whole must support these kinds of adjustments if they are to be widespread and effective.

Next steps

A proposed "core set" of environmental and sustainable development indicators for Canada

In 1987, the World Commission on Environment and Development published the groundbreaking report "Our Common Future." Since that time, efforts to measure progress towards the achievement of sustainable development have proliferated around the world, with many Canadian governments and organizations participating in the exercise. This report summarizes the results of Environment Canada-led work on national-level environmental and sustainable development indicators.

The National Round Table on the Environment and the Economy is currently engaged in an exercise to create a very small set of indicators to measure Canada's progress towards more fully integrating economic and environmental policy. Further, some sectors, such as agriculture and forestry, have put considerable effort into measuring their own progress towards the attainment of sustainable development. Likewise, many indicator initiatives have been established at the provincial, regional, and municipal levels. Finally, in recognition of the need for tools to aid in the management of transboundary ecosystems, Canada and the United States have engaged in the development of sustainable development indicators across borders, particularly in the Great Lakes, and more recently in western North America.

Environment Canada is proposing to synthesize and link this multitude of indicator efforts through the development and implementation of an indicator strategy. The strategy will provide coherence to indicator initiatives at different scales and strengthen the links between indicators and policy development. It could result in the development of a core set of indicators for Canada. It will be developed through consultations both inside and outside government. This document is meant to serve as a launching pad to start discussion on both the strategy and a core set of indicators.

Challenges and gaps in the development of a core set of indicators

Poor accessibility of environmental information has created a significant barrier to the development of meaningful environmental and sustainable development indicators in Canada. Indicator development has typically been driven by the availability of monitoring data. However, since the early 1990s, reliable monitoring data have become increasingly scarce, placing severe restrictions on the ability of all organizations to report on progress towards protecting the environment.

Some gaps in the current national environmental indicator set have already been identified. Both water quality and biodiversity are described through response indicators — municipal wastewater treatment and protected areas. Better indicators that measure the state of water quality and biodiversity are required, and, indeed, new tools in these two areas are currently being developed.

There is a dearth of credible indicators that provide easy-to-understand links between the environment and the economy, as well as between the environment and human health. A proposed new set of national accounts would further much-needed data collection and analysis to facilitate the promotion of economic/environmental links. Health Canada and Environment Canada have struck a partnership to lead the development of environment/health indicators. Future indicator development to strengthen and expand upon the links with other components of sustainable development will require commitments to research that enhances understanding in this area.

In many cases, Canadian industries have gone to great effort and expense to lighten their impacts on the environment. These efforts need to be fostered, encouraged, and better acknowledged. The profiling of achievements of responsible industries currently remains a weakness in indicator development.

Citizens have also begun to take encouraging action, some of which is reported here. For example, recycling is now a significant proportion of per capita waste generated, and per capita water use has stabilized. Future indicators will need to profile both the successes of citizens and the areas where stronger efforts need to be made.

Since the early 1980s, scientific credibility has been a cornerstone of environmental and sustainable development indicators. However, more recently, the value of historical knowledge collected by local communities and Aboriginal people has increasingly become recognized. Northern Canadian communities have led the way in developing the methodology to incorporate what is referred to as "traditional ecological knowledge" into policy development and decision-making. The challenge remains to find ways to incorporate this wealth of information into state of the environment indicator programs.

Even when the indicators show that action is needed, the mechanisms to ensure that the indicators feed back into policy development and decision-making have often been poor. There is a need to strengthen these feedback loops.

The rate of change in the economy can be rapid, and policy interventions can create improvements within annual timelines. The rate of change in the environment, however, can be comparatively slow. As a consequence, rapidly changing economic indicators give the impression of a more compelling need for immediate policy action than do slower-changing environmental indicators. However, once critical thresholds are reached, the rate of change in the environment can also be very rapid. Critical environmental thresholds are generally unknown. Commitments to future research in this area could provide the baseline against which the relative importance of environmental change can be more effectively measured.

Scientific uncertainty and time lags between human pressures on the environment and changes in the state of the environment have also hindered the use of environmental indicators in policy development. Given the current state of knowledge about how systems function, it may be possible to develop forecasting scenarios that account for uncertainty and allow indicators to be used as predictive tools rather than simply as descriptors of past events.

Indicators are generally carefully chosen to provide early warning signals. However, it has been impossible to develop measurements that are capable of capturing all emerging issues. In recent years, the impacts of biotechnology, pharmaceuticals and other health care products, and endocrine disrupting substances in the environment have emerged as new issues with unknown and yet to be measured effects. Indicator sets will always need to be adapted to include new issues as they arise.

Facing the challenges

Efforts are under way to establish, or in some cases re-establish, monitoring networks. This will help to meet the need for reliable and useful information on the state of Canada's natural capital — air, water, soils, and biodiversity — to ensure that Canadians do not exceed the capacity of the environment to provide essential ecological services.

The Canadian Information System for the Environment (CISE), being developed by the federal government in cooperation with numerous other levels of government, non-governmental organizations, the private sector, and academia, will, over time, be an important source of the environmental data needed to support indicator development and reporting on the state of the environment in Canada. This distributed information system would make environmental information available to all Canadians and at all scales, from federal and provincial/territorial to municipal, community, or watershed. It would allow for better tracking of efforts to ease impacts on the environment, easier and more timely reporting for different audiences by different organizations, and a common

information base for everyone. Although the issues that must be overcome to make this dream a reality are not inconsequential, they are technologically feasible.

The proposed core set of environmental indicators could be one important tool used by CISE to turn data into usable information. The addition of user-defined indicators to sets that are currently defined by the data producers will ensure that new indicators are more conducive to encouraging individual and institutional action.

Prioritizing environmental issues by their relative risk would help policy-makers turn their attention to the most pressing issues. Risk assessment has not been a component of environmental indicator development in the past. The development of techniques to add the concept of relative risk to indicator development needs further exploration.

The Canadian Council of Ministers of the Environment (CCME) has developed a water quality index. Although some provinces already present information based on this index, coverage of the whole country is not complete. Current efforts to provide information on the CCME water quality index in all provinces will allow a future report to provide better information on the state of water quality in Canada.

Likewise, only a partial picture of biodiversity has been possible. The Federal–Provincial–Territorial Biodiversity Working Group and Environment Canada are embarking on a three-year program to develop a Canadian Biodiversity Index. This index is currently in the infant stages of development, but promises to provide a useful tool for reporting on status and trends in biodiversity.

It may be possible to develop other environmental indices to cover other issue areas that are difficult to represent with three or four indicators. Environment Canada and other indicator practitioners are experimenting with new approaches to indicator development and presentation, such as modelling and indices development, that could provide new directions for environmental information dissemination in the medium to longer term.

Finally, the opportunities exist to tap into the energies and expertise of the range of environmental indicator practitioners that have participated in indicator work throughout Canada. With their regional and sectoral contributions, the Canadian core set of environmental indicators can become a reality. And with the help of policy-makers, scientists, and interested Canadians, a core set can be built that will be relevant and compelling.

Notes

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Websites of Interest for the Report

General

Environment Canada's State of the Environment Infobase
http://www.ec.gc.ca/soer-ree

Environment Canada's Atlantic Region
http://www.ns.ec.gc.ca/index_e.html

Environment Canada's Quebec Region
http://lavoieverte.qc.ec.gc.ca/envcan/indexe.html

Environment Canada's Ontario Region
http://www.on.ec.gc.ca/or-home.html

Environment Canada's Prairie and Northern Region
http://www.pnr-rpn.ec.gc.ca/index.en.html

Environment Canada's Pacific and Yukon Region
http://www.pyr.ec.gc.ca/index_e.htm

Biodiversity and protected areas

Canadian Council on Ecological Areas
http://www.ccea.org/wedo.html

Committee on the Status of Endangered Wildlife in Canada (COSEWIC)
http://www.cosewic.gc.ca

Species At Risk Act (SARA)
http://www.speciesatrisk.gc.ca/strategy/index_e.cfm

Canadian Wildlife Service, Species at Risk, information search tool
http://www.speciesatrisk.gc.ca/Species/English/SearchRequest.cfm

Toxic substances

National Pollutant Release Inventory
http://www.ec.gc.ca/pdb/npri/npri_home_e.cfm

Acid rain

Environment Canada's Acid Rain Website
http://www.ec.gc.ca/acidrain

Environment Canada's Air Pollutant Emissions Website
http://www.ec.gc.ca/pdb/ape/cape_home_e.cfm

Climate change

Government of Canada Climate Change Website
http://www.climatechange.gc.ca/english/index.shtml

British Columbia and Yukon Regional Climate Change
http://www.ecoinfo.ec.gc.ca/env_ind/region/climate/climate_e.cfm

Stratospheric ozone

Environment Canada's Stratospheric Ozone information page
http://www.ec.gc.ca/ozone/indexe.htm

Environment Canada's site for Ozone Depletion
http://www.mb.ec.gc.ca/air/a00s20.en.html

Municipal water use

Municipal Water Use Database
http://www.ec.gc.ca/water/mud/

Canada's Freshwater Website
http://www.ec.gc.ca/water/index.htm

Municipal Wastewater treatment

Municipal Water Use Database
http://www.ec.gc.ca/water/mud/

The State of Municipal Wastewater Effluents in Canada
http://www.ec.gc.ca/soer-ree/english/SOER/MWWE_Backgrounder_e.cfm

Chambers, P.A., M. Guy, E. Roberts, M. Charlton, R. Kent, C. Gagnon, G. Grove, and N. Foster. 2001. Nutrients and their impact on the Canadian environment.
http://www.nwri.ca/issues/nr/impact.html

Urban air quality

Environment Canada's Clean Air Website
http://www.ec.gc.ca/air/introduction_e.cfm

Environment Canada's Air Quality Services Website
http://www.msc-smc.ec.gc.ca/aq_smog/index_e.cfm

Environment Canada's Air Pollutant Emissions Website
http://www.ec.gc.ca/pdb/ape/cape_home_e.cfm

Forestry

Canadian Forest Service
http://www.pfc.forestry.ca

National Forestry Database Program
http://nfdp.ccfm.org

Canadian Forest Service: Criteria and Indicators Report
http://nrcan.gc.ca/cfs/proj/ppiab/ci/indica_e.html

Agricultural soils

Agriculture and Agri-Food Canada
http://www.agr.gc.ca

Report of the Agri-Environmental Indicator Project
http://www.agr.gc.ca/policy/environment/eb/public_html/ebe/aei.html

Energy consumption

Natural Resources Canada, Office of Energy Efficiency
http://oee.nrcan.gc.ca

Passenger transportation

Transport Canada's Transportation in Canada 2000: Annual Report
http://www.tc.gc.ca/pol/en/anre2000/tc0013ae.htm
http://www.tc.gc.ca/pol/en/T-Facts3/Transportation_Annual_Report.htm

Natural Resources Canada, Office of Energy Efficiency: Transportation Sector 1990–1999
http://oee1.nrcan.gc.ca/neud/dpa/transport.cfm?PrintView=N&Text=N

Statistics Canada: Guide to Transportation Data
http://www.statcan.ca:80/english/freepub/50F0001GIE/free.htm

Statistics Canada: Canadian Vehicle Survey, Annual
http://www.statcan.ca:80/english/freepub/53-223-XIE/free.htm

Municipal solid waste

Statistics Canada: Waste Management Industry Survey, Business and Government Sectors
http://www.statcan.ca:80/english/freepub/16F0023XIE/free.htm

What you can do to live sustainably

Environment Canada: What you can do
http://www.ec.gc.ca/eco/main_e.htm

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